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WATER QUALITY BASELINE ASSESSMENT FOR THE CLEVELAND AREA, LAKE ERIE. VOLUME II. THE FISHES OF THE CLEVELAND METROPOLITAN AREA INCLUDING THE LAKE ERIE SHORELINE

Andrew M. White, et al

Cleveland Department of Public Utilities

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February 1975

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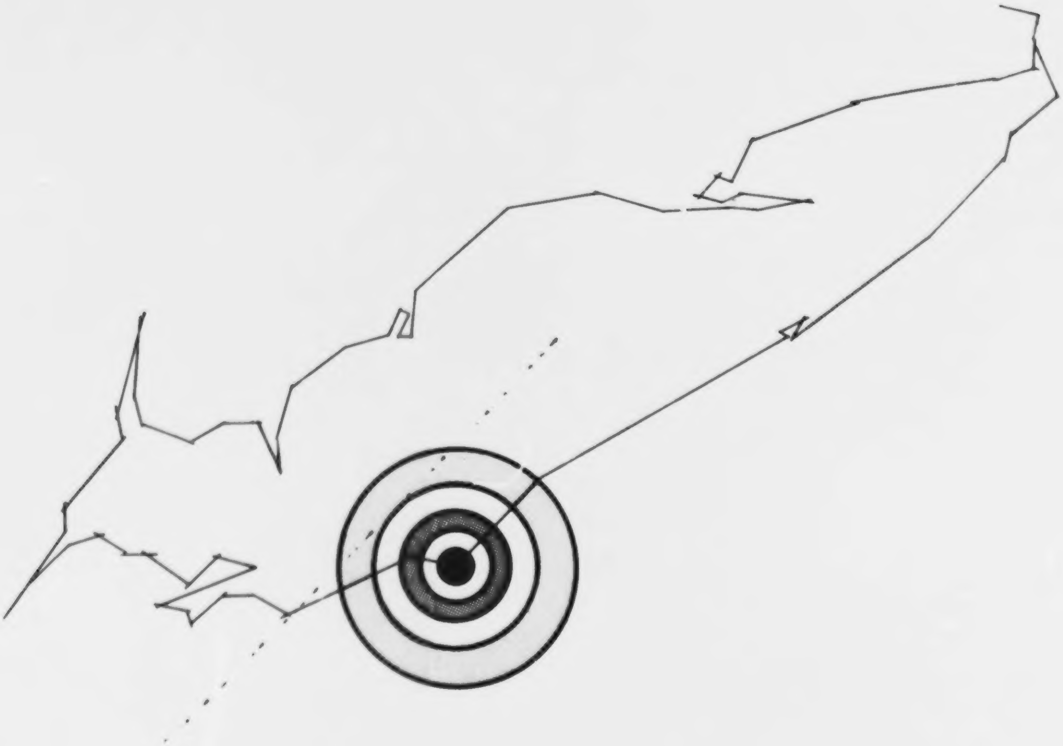

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16. ABSTRACT

The fish fauna in the near shore waters of Lake Erie and the Three Rivers Watershed were investigated from July 1971 through December 1972, and in 1973, 1974. This investigation was performed by the John Carroll University as a part of a broader City of Cleveland study (Volume I) to establish a baseline for planning and measuring the restorative value of water pollution abatement programs.

The study established a baseline of the existence of fish species; their relative abundance and distribution; the habitat degradations due to pollution and their effects on changes in fish population diversity, distribution and abundance.

The 86 fish species presently inhabiting the study waters are markedly different than the 107 species documented historically in former times. Changes in fish species are attributed to stream obstruction, pollution, siltation, loss of aquatic vegetation and other causes.

The report concludes that the recovery of most species of fish to levels of previous abundance is possible by the use of recommended pollution abatement and habitat restoration measures. The potential economic significance of these measures to the fishing industry in the Cleveland area is assessed, as a further planning index.

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WATER QUALITY BASELINE ASSESSMENT FOR THE CLEVELAND AREA - LAKE ERIE

VOLUME II

The Fishes of the Cleveland Metropolitan Area Including the Lake Erie Shoreline

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ABSTRACT

This work was part of a first phase of an environmental assessment for planning and evaluation in urban pollution abatement for the Cleveland metropolitan area. Other areas of baseline assessment for the City of Cleveland were summarized in 'Volume I - Synthesis' of this project report series.

This report, Volume II, presents the results of the first phase of the baseline study of the Cleveland metropolitan area fisheries. The study investigated the past and present distributions and abundances of 107 species and subspecies of fishes known to have inhabited the Cleveland area streams and Lake Erie shoreline. Preliminary investigations concerning the age and growth rates of the Yellow Perch in Lake Erie were undertaken.

The study was conducted at John Carroll University by a team of faculty and graduate students. Field investigations were conducted from July 1, 1971 through December 31, 1972. Additional data were collected throughout 1973 and 1974, portions of which are included in this publication. The study area included the Lake Erie shoreline from the mouth of the Chagrin River to the mouth of the Rocky River, a distance of 35.5 kilometers. Samples were also collected in the drainages of the three major rivers in the Cleveland area, the Chagrin, Rocky and Cuyahoga.

The study established a firm baseline of information concerning the presence or absence of fish species in the study area. Relative abundances and distributional patterns of each species were determined. These were compared to past information in order to determine and present an accurate evaluation of the series of events which affected the local fish populations. Areas of habitat degradation are discussed as cause and effect relationships are presented. Changes in fish population diversity, distribution and abundance are discussed.

The study demonstrated that the fish fauna is markedly different than in former times. The presence of at least small, isolated populations of 86 species and subspecies was documented, and the recovery of most species to at least a portion of their former abundance was considered possible with the implementation of pollution abatement programs and habitat restoration. The study also documented significant adverse affects of environmental degradation on fish populations prior to 1850. The causes of the change in species composition in the Cleveland area is attributed to several factors, among which are stream obstruction, pollution, siltation, and the loss of aquatic vegetation. It was

determined that point sources of pollutants were only one of several detrimental factors which must be considered before restoration of the fish species can be accomplished.

This report is submitted in partial fulfillment of project number G005107.

Sportsmen "snagging" Coho Salmon in the Chagrin River, Willoughby, Ohio, November, 1972.

Young-of-the-year Eastern Gizzard Shad which winter-killed in the Cleveland Harbor. This photo is a portion of a kill in 1975 which was estimated to have contained over 150,000 individuals. Such winter-kills are not associated with toxins or organic pollutants but are the result of the inability of small shad to survive the cold winter temperatures of Lake Erie.

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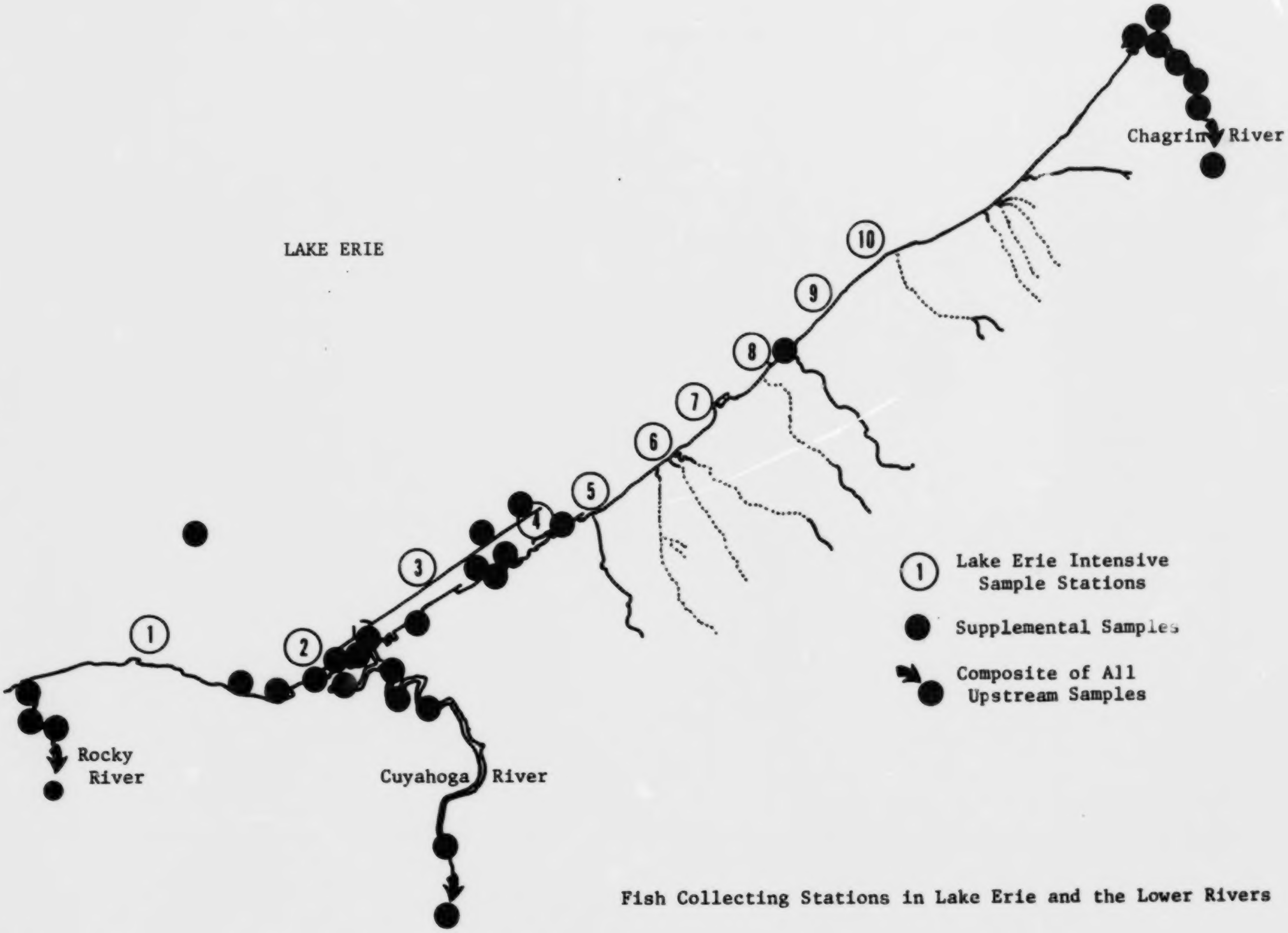
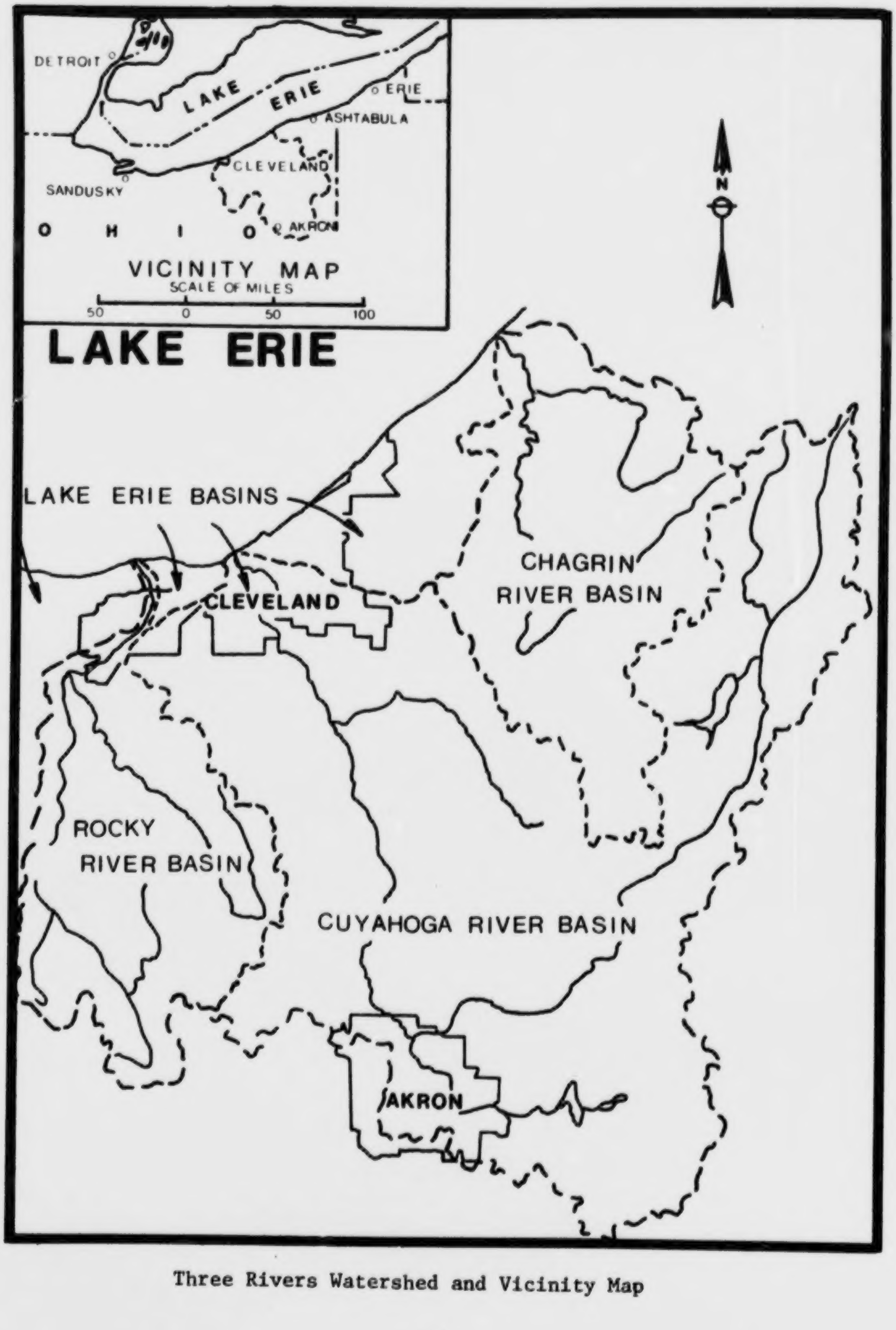
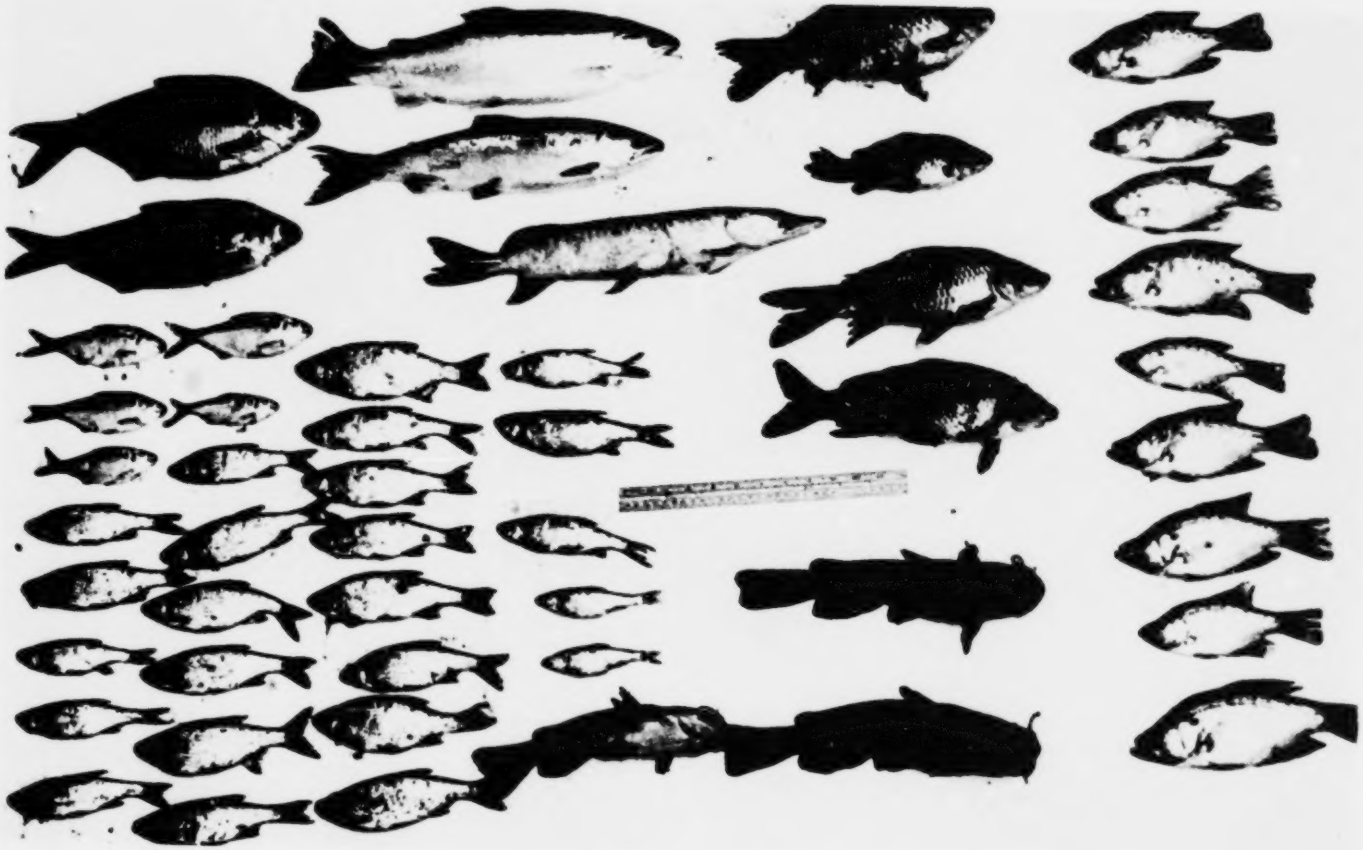


Fish Collecting Stations in Lake Erie and the Lower Rivers



Three Rivers Watershed and Vicinity Map



A 24 hour collection made with a 125 ft. experimental gill net placed in a protected portion of a marina within the Cleveland Harbor, Cleveland, Ohio; April, 1974.

(A) 7 Eastern Gizzard Shad; (B) 22 Golden Shiner; (C) 2 Spottail Shiner; (D) 1 Rainbow Trout; (E) 1 Coho Salmon; (F) 1 Northern Pike; (G) 2 Goldfish; (H) 2 Carp: (I) 1 Black Bullhead; (J) 2 Brown X Black Bullhead; (K) 9 Crappies (Black,White and Hybrids).

A sample of fish specimens prepared for permanent storage in the John Carroll University Museum. Such specimens will be maintained for documentation and future research.

SECTION I

CONCLUSIONS

After a complete review of all pertinent data concerning the past and present fish populations in the Cleveland Metropolitan Area, several conclusions can be made. Other, more specific conclusions are based primarily on the information collected during this phase of the study and are of significance especially to the future documentation of the restoration of the Cleveland rivers and shoreline. Many of these, however, should be applicable to other areas both of distressed and recovering ecosystems and as such these data and conclusions become more important. We should hope that the conclusions of this report would be applied in other regions for research and monitoring efforts in addition to those in Cleveland, Ohio.

1. It is concluded that the fish populations of the Cleveland Metropolitan Area are under stress from the degradation of the ecosystem and that the stress varies significantly within the study area. The most highly distressed area is the lower 7 miles of the Cuyahoga River and the least distressed area is the middle and upper portions of the Chagrin River system. Other areas display various degrees of degradation.

2. In the entire study area, including the lower Cuyahoga River, there were no areas found where a fish fauna was completely absent. While the fauna of the most distressed reaches of the Cuyahoga River is meager, consisting of only occasional individuals of a few species, it is concluded that fishes routinely enter the lower reaches of this stream from the Cleveland Harbor. The most commonly collected species were the Goldfish, the Emerald Shiner and the Eastern Gizzard Shad.

3. The fish fauna of the Cleveland-Lake Erie shoreline is, at present markedly different than in former times. The species composition has changed from one of highly valuable food species and clean water forms (ie. Muskellunge, Walleye, Lake Trout, Silver Chub, Burbot), to one of a predominance of rough fish and low value food species such as the Goldfish, Carp, Gizzard Shad, Yellow Perch and Drum. The species have changed from large piscivorous species to primarily plankton and bottom feeding fishes.

4. The decline and change in the fishery in Lake Erie and in the rivers did not primarily occur in the past few years. The first major decline in the fishery occurred prior to 1840 and included the nearly complete collapse of the local

populations of Muskellunge, Northern Pike and other stream spawning species. These species have not recovered since. This first decline was caused by the blockage of streams by dams, thus restricting access by many species to their upstream spawning grounds.

5. The second major decline in the fishery occurred during the period from 1860 - 1890 and appears to be rather well correlated with the deterioration of the Cuyahoga River during the rapid growth of the City of Cleveland. Although the decline is not as well documented as the most recent one, it appears that the Cuyahoga became grossly polluted during this period, perhaps more polluted than at present. The principal species affected during this period were the Walleye, Smallmouth Blackbass and shoreline species such as the darters and shiners. Several species became extirpated from the area during this period.

6. A third period of major decline occurred during the 1950-1960 period. The Blue Pike, Walleye, Burbot and many others suffered a sudden and drastic reduction in numbers. While the Walleye appears to have made a partial recovery in the Eastern and Western Basins of Lake Erie, its numbers in the Cleveland Area remain critically low. The Blue Pike is considered by many to be extinct at the time of this writing, and the Burbot has been placed on the list of Ohio endangered species.

7. The primary cause of the decline in the Cleveland Area fish populations is the destruction of spawning grounds and the elimination of access to such localities by the activities of man in the study area. We feel that the sport or commercial removal of fishes played a minimal part in the reduction of the fish fauna.

8. The species of fishes which have most severely declined are those which spawned in the upper sections of the river drainages, entering in spring from Lake Erie. The former spawning grounds of these fishes have either been drained, silted or blocked by construction of dams.

9. Those species which formerly spawned in the lower river mouths or on gravel bars and beaches along the shoreline have also declined sharply since 1850, because of siltation, dredging and industrial or municipal pollution.

10. Species which spawn in offshore, deeper portions of Lake Erie have shown the least reductions in numbers, and many of

these (Drum, Smelt) have increased greatly in number.

11. Literature, museum and present survey records indicate that a total of 101 species and 6 additional subspecies of fishes have at some time inhabited the study area. Presently, our survey indicates that 47 (45%) of these are either rare or probably extirpated within the study area. Of the 107 forms, we have documented the presence of 87 within the area. It is probable that several more exist in very small numbers.

12. Major fish concentrations are correlated with (1) a nearby municipal pollution source, or (2) a warm water effluent or (3) protected waters such as marinas, harbors or river mouths. These concentrations are to be expected and have been documented in other studies.

13. The principal concentrations of sport fishing activities are associated with the preceding localities.

14. The principal sport and commercial species along the Lake Erie Shoreline are Yellow Perch, Drum (Sheepshead), Carp and White Bass. The Yellow Perch contributes the greater portion of the catch.

15. Successful reproduction of 24 species of fishes has been documented within the Cleveland Harbor and adjacent marinas. Two species, the Goldfish and Green Sunfish are reproducing in the lower 5 miles of the Cuyahoga River.

16. The major nurseries along the Lake Erie shoreline are (in order of decreasing production), the Cleveland Breakwall and adjacent marinas, the lower Chagrin River, the lower Rocky River, the Lake Erie Shoreline and the lower Cuyahoga River. The Chagrin has a greater variety of species.

17. In general, the species diversity index (Shannon-Weaver) and the species composition along the Cleveland-Lake Erie shoreline is low at a depth of 20-30 feet. Collections show that there is a trend toward a more diverse and abundant fish fauna to the east and west of Cleveland. The fauna near the mouth of the Chagrin River is most diverse.

18. The species diversity index increases as collections are taken nearer to shore, and excluding river mouths, the most diverse and abundant fish fauna along the Lake Erie shoreline occurs in the shoreline marinas, especially within the Cleveland Harbor System.

19. In the entire study area, the most diverse fauna occurs in the lower 5 miles of the Chagrin River. In this area, the diversity index is often in excess of 3.0. More than sixty species have been collected.

20. The species diversity and relative abundance of fishes changes seasonally along the Cleveland shoreline because of the seasonal use of the area by various species (Drum, Gizzard Shad, Trout-perch, etc.). The diversity is highest in the early spring (March-April) and is lowest in the late summer (July-August). Summer samples are not the most representative of the fish fauna along the Lake Erie shoreline.

21. This diversity and abundance of fishes along the shoreline does not vary considerably during a season, indicating little or no avoidance of selected areas by pelagic species. Further, the species composition of the fishes in the shoreline marinas (including within the Cleveland Harbor) does not vary significantly during the entire year. This indicates that local, resident populations inhabit the marinas and that they are not transients. Species such as Largemouth Blackbass, White Crappie and Northern Pike are collected in these areas during all seasons of the year.

22. Species diversity and relative abundance of fishes changes on a regular basis in the lower rivers and may change greatly from week to week, day to day, or day to night. Any evaluation of the fish fauna of a lower river should involve several collections and these collections should be taken during spring and late fall, and if possible should involve night collections.

23. The formerly valuable commercial and sport fishery for Blue Pike and Walleye in the Cleveland area has at present diminished to zero. Although the Walleye appears to be recovering in certain areas of the Eastern and Western Basins of Lake Erie, neither have recovered in the Cleveland area. According to our collections and observations between 1971 and 1974, it appears that the populations of the Yellow Perch in the Cleveland Area are currently suffering a precipitous decline. The population presently consists of very few adults (III+ or older) and the numbers of II+ individuals has seriously declined. The commercial and sport fishery is supported by this species in the Cleveland Area, and both are meeting with poor success in 1974.

24. It is estimated that the loss to the Cleveland Area because

of the collapse of the commercial fisheries is more than $8,000,000.00 annually. This does not include the estimated loss resulting from the near collapse of the sport fishery and its revenues (tackle, boats, bait, gasoline, lodging, etc.). Many investigators have calculated (for other areas), that sport fisheries revenues often exceed those derived from commercial fisheries.

25. Forty-six species and subspecies of fishes have been documented as present within the Cleveland Harbor and adjacent marinas. Many of these exist in limited areas, consist of small populations, and exhibit minimal reproductive success.

26. The number of species and subspecies which were documented as present in other sections of the study area are summarized below. (Lists may include same species in two stream sections).

78 species and subspecies in the Chagrin River system,
  67 in the lower section and
  56 in the middle and upper reaches.

58 species and subspecies in the Rocky River system,
  40 in the lower section and
  46 in the middle and upper reaches.

47 species and subspecies in the Cuyahoga River system,
  8 in the lower section
  14 in the middle section and
  39 in the upper reaches.

50 species and subspecies along the Lake Erie shoreline from the Rocky to the Chagrin rivers.

27. According to the composite list of Ohio endangered fish species, compiled from "Rare and Endangered Vertebrates of Ohio" (Smith, H. G., R. K. Burnard, E. E. Good, and Keener; Ohio Journal of Science 73 (5):257-271) and a more recent list prepared by the Ohio Division of Wildlife; (August 1974) endangered species exist within the study area. These are as follows:

1. Silver Lamprey, Ichthyomyzon unicuspis
2. American Brook Lamprey, Lampetra lamottei
3. Lake Muskellunge, Esox m. masquinongy
4. River Chub, Nocomis micropogon
5. Bigmouth Shiner, Notropis dorsalis
6. Pugnose Minnow, Notropis (=Opsopoeodus) emiliae
7. Lake Chubsucker, Erimyzon sucetta
8. Burbot, Lota lota maculosa

28. The Cleveland Area can be restored to its former position as a viable fishery, although certain species will be difficult if not impossible to restore. Should the conditions along the shoreline and in the rivers improve, most species would recover quickly.

29. The reports of Simpson, et al., of Havens and Emerson Ltd. (135, 136) are misleading and unacceptable to us, insofar as the fisheries are concerned. These reports indicate a poorer quality of fish life than is actually present. They reported less than 20% of the present fish fauna of the Chagrin River drainage. Their reports of Carp and bullheads and little else at their lower Chagrin River stations is inaccurate because we have routinely collected more than 25 species per hour at the same locations. At some of the stations which they had sampled, we have collected over 45 species in a single day.

The explanation that the environment has significantly improved since 1970 does not explain these dissimilarities in results. Disjunct populations are present in the Rocky River (Bigmouth Shiner, Notropis dorsalis) and in the Chagrin River (Pugnose Minnow, Notropis emiliae); these are considered to be endangered Ohio species. These species are very unlikely to have repopulated these streams since 1970, for they are the only local sources for restoration.

If we assume that these species were present, but were not collected because of their low numbers; it is difficult to understand why so many associated species of shiners, minnows, chubs and suckers were not collected. Our collections indicate that some of the most abundant species in the area are not represented in the findings of these authors. We conclude that their collections are inadequate and misleading. To utilize their data for the determination of water quality would yield incorrect conclusions.

SECTION II

RECOMMENDATIONS

Concerning the protection of existing fish stocks, we feel that certain areas should be discussed as important sources for the future, natural repopulation of the Cleveland metropolitan area. These areas should be considered as potential sources for the population of distressed areas, and as such should be protected. The most important of these areas are as follows:

(1) The Entire Chagrin River Drainage

The Chagrin River drainage is the most important reserve of fish species in the study area. Nearly 80 of the original 107 species and subspecies of fishes probably still inhabit the drainage, and 74 of these have been observed during this study.

This stream is the only one within the study area capable of supporting the Rainbow, Brown and Brook Trouts and contains reproductive populations of Rainbow Trout in the headwaters of the East Branch. Portions of this stream system harbor several species which are considered rare or endangered within the State of Ohio: Brook Trout, Great Lakes Muskellunge, River Chub, Pugnose Minnow, Silver Lamprey and American Brook Lamprey. The stream may also contain populations of the Sand Darter, Iowa Darter and Northern Shorthead Redhorse.

The Chagrin River system seems to contain the only remaining spawning and nursery areas for several species within the study area (Northern Pike, Great Lakes Muskellunge etc,) and as such is extremely important to the restoration program in this region.

Should the Chagrin River system, especially the lower and extreme headwater areas, become degraded within the next few years, the restoration of many species in the Cleveland area would become more difficult, if not impossible.

(2) The Rocky River, the Middle Portions

The middle portions of the Rocky River is an important source of fish stocks for repopulation of the drainage. The fauna is not as diverse as in the Chagrin, but stream species necessary for the restoration of the lower sections are present in this middle portion. It is also important since it contains one of the remaining two populations of the Central Bigmouth Shiner, an Ohio Endangered Species.

This stream, as with the Chagrin, is an important feeding ground for some Lake Erie game species and is a stock source for Smallmouth and Largemouth Blackbasses.

(3) The Cuyahoga River, the Upper Portions

If the Cuyahoga River is to be restored, we must rely on the fish stocks now present in the upper third of the drainage. In these areas, nearly all of the former Cuyahoga fish species persist, and populations of two Ohio endangered species, The Hornyhead Chub and Lake Chubsucker, are present.

Local, State and Federal agencies should begin to investigate the possibilities of fish meal production from the Central Basin of Lake Erie. Rough fish removal by commercial fisheries would tend to improve a declining industry while at the same time removing unwanted species and large quantities of organic material from the Lake.

Investigations should begin immediately by all agencies, concerning the removal of all unnecessary stream obstructions or the creation of alternative migration routes around these structures for the passage of Lake Erie and stream species of migratory fishes. Obstruction removal should begin with those structures located nearest to Lake Erie and proceed in an upstream direction. The first structure to be considered is the Willoughby Dam, on the Chagrin River. This would allow passage of Lake Erie and Lower Chagrin species into the entire East Branch drainage and a large portion of the middle Chagrin River.

Areas of remaining marshlands should be protected, especially those near the Lake Erie shoreline. The shallows near the mouth of the Chagrin and Rocky Rivers should be considered for State Wildlife Areas, and should be managed as fish spawning grounds. Such areas could also be utilized for other non-consumptive recreation such as birdwatching, nature photography,etc.

Land use programs should be developed for areas in the headwaters of stream drainages. Erosion control measures should be developed and strictly enforced.

Where possible, programs should be implimented to restore the forest canopy over the smaller streams in the area. This would help to prevent bank erosion, thus reducing siltation, and would provide cover for fishes in streams. Such a canopy would tend to shade the smaller tributaries and cool the waters in summer.

Municipal and industrial point sources of pollutant input should be strictly controlled. Effluents should be treated as effectively as technology will provide and efforts should be made to improve such treatment as time progresses.

Studies should be initiated to investigate the feasibility of artificial habitat restoration in highly polluted areas. Evidence from this study indicates that the fishery within the Cleveland Harbor could be greatly improved by the addition of artificial substrates in selected areas which would serve as spawning and nursery areas. Many species are already utilizing artificial substrates in lieu of natural materials, indicating the feasibility of such a program, (see Species Accounts; Yellow Perch, Largemouth Blackbass).

Studies should be initiated concerning the food chain relationships between fishes, benthos and plankton. Such investigations would reveal the value of certain food species to fish production and would provide information documenting the value of specific habitats in polluted ecosystems.

A more thorough documentation of the distribution of rare and endangered Ohio fish species is imperative. It is evident that two of these may occur only in the Cleveland area, and as such should be protected by the State of Ohio. Documentation of their distribution would enable the Ohio Division of Natural Resources to protect certain selected portions of habitat from adverse factors affecting these species.

Sport fishing for Largemouth Blackbass in the Cleveland Harbor should be prohibited during the spawning season. Our observations indicate that production of this valuable game species is greatly hampered by sportsmen removing Blackbasses from their nests in marinas and along the Cleveland breakwall.

SECTION III

INTRODUCTION

GENERAL COMMENTS

Originally this research project was undertaken to establish a baseline of information concerning the past and present species composition, relative abundance and seasonal fluctuations of the fishes of the Greater Cleveland Metropolitan Shoreline. Preliminary investigations were to be initiated concerning the age and growth structure, feeding behavior and migrations of Lake Erie fish populations within the study area. In addition, heavy metal analysis of food fish species were to be undertaken.

As a result of initial findings, we were instructed by officials of the U. S. Environmental Protection Agency to concentrate on the ecology of fish populations rather than pursue the heavy metal analysis.

It became apparent early in our investigations that it would be difficult, if not impossible, to separate the near-shore areas of the lake from the river drainages in regard to fishes.

Therefore, it was decided not only to investigate the shoreline area in Cuyahoga County from Lakewood Park east to Moss Point, but to include the Rocky, Cuyahoga and Chagrin river drainages. It also became necessary to conduct a literature survey for the period from 1790 to present because it was important to have information concerning the chronological changes of the area in regard to the fish populations and water quality.

Since the Yellow Perch (*Perca flavescens*) was the most important food fish, a study of growth rate, coefficient of condition (K), age composition and seasonal fluctuation was considered necessary. Those species of fishes which were collected as either fry or young-of-the-year were considered to be either reproducing in the study area or utilizing the area as a nursery ground.

Fishes as Indices

The presence or absence of particular species of fishes has often been used as an indicator of water quality. Certain species have a limited "home range" and therefore may serve well as indices of the local effects of water quality degradation. These species, especially those that are intolerant of pollutants (Ammocrypta, Percina), may also serve as excellent indices of short term pollutants that may go undetected, especially by bi-weekly or monthly chemical monitoring programs. Conversely, since some fishes are highly mobile, they may temporarily enter a grossly polluted zone (such as the Lower Cuyahoga

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River). It is important that their presence should not be improperly evaluated or overstressed. The fact that a species is occassionally present or even commonly present at such a site indicates only that the species is capable of surviving and not that the population is reproducing, feeding, growing, etc.

In order to obtain an accurate evaluation of the impact of man on the population of fishes, an evaluation of all factors must be considered. Such an evaluation must include not only the presence of species, but also their diversity, relative abundance, reproductive success, growth rate as well as other factors.

This information must be correlated with the chemical environment, benthos and planktonic community structure, physical characteristics of the area and other biological parameters in order to achieve a more complete picture of the cause and effect relationships which have resulted in the present status of fishes in any given body of water.

FACTORS AFFECTING FISH POPULATIONS

It is erroneously believed by some that all of a fish species' requirements are met if there is sufficient oxygenated water present, and many regulations have been passed which pertain to O_2 levels for fishes. In addition to sufficient oxygen levels, however, many other factors constitute a fish's life cycle, such as adequate spawning areas, access to the proper habitat, favorable conditions for the growth and development of fry, available food for young and adults, proper temperature , presence or absence of aquatic vegetation (often of the proper plant species), presence of sheltered waters and many other factors. If one or more of these factors are absent, even for a short period of time, the abundance of a species may become greatly reduced, or the species may become extirpated; even though oxygen or temperature values may remain within an acceptable limit of tolerance.

Unless a species of fish has all of the requirements of its life history, its future survival is in serious doubt. If any of these requirements is absent, the species will be absent. For example, it is obvious that the tributary streams play a very important, if not an essential role, as a nursery for some Lake Erie species. Even though the water quality of such a stream might remain satisfactory for a given species, a decrease in abundance could be caused by a single factor, such as a dam, which would effectively block all upstream migrations to the spawning grounds. It is conceivable, therefore, that a species may be brought to near extinction without the addition of any industrial or municipal pollutants. While we recognize that such a physical blockage of streams might be a cause of the decrease in a certain population, we also recognize that additional factors are at work at the present time. To assume that the removal of such structures, or any other single detrimental factor, may bring about a recovery of the species is an invalid assumption, since the effects of other factors play an equivalent or perhaps greater role in the disruption of the life history of the fish. A full comprehension of the interrelationships between each of these factors and the total life history requirements of each species of fish is essential in understanding the current status or methods of restoring Lake Erie fishes.

Some of the most important factors affecting the Cleveland area fish populations are discussed as follows:

FACTORS AFFECTING LOCAL FISH POPULATIONS

Stream Obstructions

Arriving in Ohio, the early settlers needed power and the most readily available source was water. In response to this need, hundreds of small dams were built and placed in use during the first quarter of the 19th Century. These structures were among the first causes of a major decline in the populations of some Ohio fish species (147),(Fig. 1).

As a general rule, most species of Ohio fishes are migratory, at least when ready to spawn. These migrations may take several forms. The Burbot (*Lota lota maculosa*) migrates from the deeper portions of Lake Erie toward the shoreline, where it spawns in the shallows or in the mouths of rivers during February. The Whitefishes and Ciscoes remained in the deeper waters of the Central and Eastern basins during the summer, migrating westward to the Western basins in fall, where they spawned primarily among the reefs. Other species, such as the Sturgeon (*Ancipenser fulvescens*), suckers of the genus (*Moxostoma*, Smallmouth Blackbass (*Micropterus dolomieui*) and Walleye (*Stizostedion v. vitreum*), migrated from the lake or lower portions of the rivers, upstream to spawn in higher gradients.

The Lake Muskellunge (*Esox m. masquinongy*) and the Northern Pike (*Esox lucius*) sometimes made extensive migrations from the Lake, going upstream many miles where they spawned among the flooded terrestrial and aquatic vegetation. Even small species such as the darters (Etheostomatidae) and shiners (*Notropis*) apparently migrated short distances of a few miles and there is evidence that the Longnose Dace (*Rhinichthys cataractae*) migrated from Lake Erie to the upper portions of river drainages to spawn.

It is obvious that any structure such as a dam which prevents or hinders upstream migrations would be detrimental to the sustained productivity of many species. Without access to their spawning ground, they may be rendered nearly unreproductive except possibly during periods of high

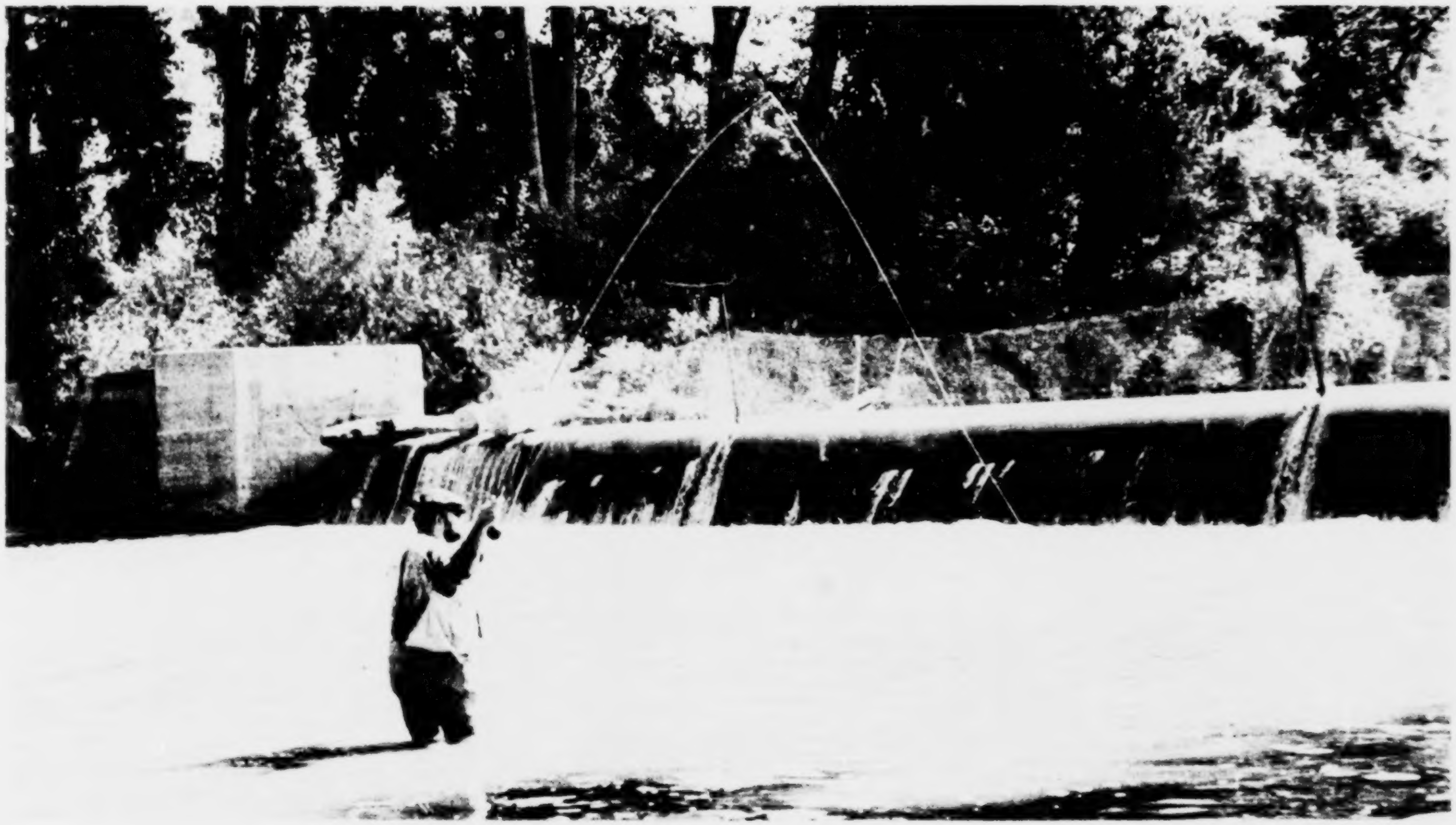

Figure 1: Stream Obstruction at Willoughby, Ohio.
Dams such as these block the spawning runs and upstream migrations of many species of fishes. The wire fencing placed on the top of this dam is to prevent salmon from jumping the structure during their migration.

water when migrating adults might bypass the obstructions. Even the bypassing of these dams was probably inconsequential, because although some spawners might succeed in bypassing the obstruction, ditching, draining, and increased siltation may have destroyed their former spawning grounds. In more recent years stream obstruction has taken the form of what we might term "chemical dams". The lower portions of many streams are now impassable for most species of fishes because of industrial and municipal pollutants. Such a situation is surely as effective an obstruction as a physical structure.

Ditching and Draining

It was necessary for the early pioneers to ditch and drain the marshlands and swamps near rivers so that they might be utilized for agriculture. Ditching and draining adversly affected a great variety of fish species. Permanent residents of the swamplands such as the Mudminnow (Umbra limi), Brook Stickleback (Culaea inconstans) and Iowa Darter (Etheostoma exile) were reduced due to the destruction of habitat. Such species are the Lake Muskellunge and Northern Pike, which utilized these undrained areas as spawning grounds, were denied the necessary habitat for reproduction.

As a secondary effect, draining often lowered the water table, thereby reducing the annual sustained flow of tributary streams. These streams became intermittent and no longer served as nurseries for other species not normally associated with marshes (ie Smallmouth Blackbass). Frequently, these streams trapped all fishes present in the drying pools during late summer.

The loss of marshlands and the resultant increased speed of draining caused a more rapid run-off of water during storms. This resulted in more frequent and more violent flooding. Unfortunately, ditching, draining and channelization continues.

Siltation

Another effect of ditching, draining and channelization was the increased erosion of soils adjacent to the stream. This resulted in higher turbidities and the deposition of large quantities of silt on the formerly clean stream bottoms. The removal of the forest canopy resulted in an increased erosion since raindrops directly striking the light humus soil eroded rapidly and deposited additional loose material in streams. The plowing of the lighter soils further resulted in greatly increased deposition of silt in streams. In many cases, it took only a very small deposition of silt over the formerly clean gravel, boulders and sand to partially or entirely eliminate spawning.

Especially affected were the Bigeye Chub (Hybopsis amblops), the River Chub (Nocomis micropogon) and the Hornyhead Chub (Nocomis bigutattus), all of which spawned on silt-free gravel riffles. Such pool species as the Mimic Shiner (Notropis v. volucellus) which spawned over silt-free sands also declined in numbers. The Sand Darter (Ammocrypta pellucida) demonstrated a great decline in numbers in this area and throughout Ohio during the early years. It appears logical to assume that this was the direct result of the siltation of clean sandy substrates in the streams. The recent decline of the Silver Chub (Hybopsis storeriana), a lake species, may possibly be attributed to the siltation of the gravel substrates in Lake Erie.

Siltation also affected a large segment of the invertebrate fauna, by smothering the substrates and eliminating their habitat. Molluscs were especially affected, and in Ohio, many species were extirpated as early as 1850.

The deposition of silts has long been a major factor in the decline of fish populations both in tributary streams and in Lake Erie. Spawning and nursery grounds have been covered, the insect species utilized as food have been greatly reduced or extirpated and aquatic vegetation has been destroyed. Siltation continues to be a major problem in the Cleveland area.

Organic Pollutants

Organic material, as with silts, is a pollutant which has been an adverse factor since the early 1800's. As Cleveland grew, the demand for lumber increased tremendously, resulting in the rapid deforestation of the area. Sawdust from lumber mills was usually dumped into the streams or along the banks. During warm water periods oxygen was depleted, sometimes resulting in massive fish kills. Organic refuse from slaughter houses and breweries contributed to oxygen depletion.

As Ohio continued to grow, domestic sewage became an ever increasing problem. Professor Orton (Howe 1900, 1:89) stated that prior to 1858 the amount of contamination was becoming both relatively and absolutely larger and not a single town had met this urgent demand of sanitary science, and that many streams had become open sewers.

As the population of Cleveland has increased, the problems of organic pollutants has shifted from sawdust and mash to domestic sewage. The effects of this organic material on oxygen depletion in the rivers and lakes is well known today and continues to be a major problem in the study area, as well as elsewhere.

Inorganic Pollutants

Throughout the early years, prior to 1825 there were only a few inorganic wastes which contributed adversely to fish populations in Ohio. Tannic acid resulting from both the lumbering industry and from tanning factories was probably the major contributor.

After 1825, the development of heavy industry resulted in increasing number of inorganic pollutants. This increase in types and amounts of inorganics continued until some streams became uninhabitable by fishes. In some areas, these deplorable conditions remain. Inorganic pollutants also eliminated essential factors in the life histories of some fish species. The loss or reduction of feeding and spawning grounds have eliminated or greatly reduced many fish species. The Walleye and White Bass (*Morone chrysops*) were particularly affected because these species were regularly entering the lower portions of streams to feed.

Aquatic Vegetation

Many species of fishes rely upon various types of submerged or emergent aquatic vegetation for shelter, food, spawning and/or the development of young. In pursuing *The Fishes of Ohio* (147), it becomes obvious that a goodly proportion of the species of fishes which have drastically decreased in numerical abundance or appear to have been extirpated from most or all of Ohio, are those requiring aquatic vegetation in some phase of their life history.

Siltation and turbidity were the primary cause of the loss of aquatic vegetation through lessening of light penetration and the covering of plants with a layer of silt. The loss of aquatic vegetation beds resulted in an increased turbidity and even greater rate of erosion, as evidenced by present day Lake Erie Shoreline.

The loss of aquatic vegetation resulted in the reduction of many fish species, through the loss of feeding and spawning areas and protection for young and adults. The Grass Pickerel (*Esox americanus*) Pugnose Minnow (*Notropis emiliae*),Blackchin Shiner (*Notropis heterodon*), Golden Shiner (*Notropis crysoleucas*), Pumpkinseed Sunfish (*Lepomis gibbosus*), Black Crappie (*Pomoxis nigromaculatus*) and Tadpole Madtom (*Noturus gyrinus*) have declined proportionally to the reduction in the amount of aquatic vegetation.

In many cases, rooted aquatic vegetation has been almost or entirely eliminated through the adverse effects of dredging, siltation, organic and inorganic pollutants and the results of higher turbidities.

Nutrient Enrichment

During the past 100 years, the substrates and waters of Lake Erie and its tributaries have become increasingly enriched (37). Originally, the water contained less nutrient material, was less turbid and presumably was cooler. Recently, the higher temperature of the waters combined with an increased concentration of nutrients has resulted in greater frequency and duration of algal blooms.

At first the primary source of enrichment was organic matter entering streams from the forest, fields and marshlands. Later, the refuse from lumber mills (sawdust), breweries (mash), graineries (chaff, flour) and slaughter houses (carcasses, offal) added greatly to the nutrient input in the lower Cuyahoga River and Lake Erie. More recently, enrichment has been greatly accelerated by the leaching of commercial fertilizers from agricultural and suburban lands, detergents, domestic sewage and other industrial and municipal sources.

It is probable that this over-enrichment has led to an accumulation of organic material in all portions of Lake Erie. The decay of this material has seriously lowered the dissolved oxygen in many portions of the Lake, and according to Hartman (37);

> "...low oxygen stress on the benthos and fish communities is becoming of consequence."

Litter

Litter has been a part of Ohio streams since the days of the early pioneers. Discarded saw-logs, bark, metal, ceramics and other materials were piled along stream banks. This practice was convenient since flooding streams would periodically carry away all the refuse. This practice has continued, but more recently the litter has taken the form of slowly deteriorating aluminum cans, glass, automobile tires, and large quantities of household and industrial items of plastics (Fig. 2).

After floods, the trees along the banks of streams are often festooned with sheets of plastic. Gill net samples taken along near-shore areas of the lake often contained few fish and large amounts of trash and junk. Seining often produced many cans and bottles. Besides being unsightly, this debris is hazardous to recreational activities. Many swimmers and stream fisherman are injured each year and thousands of dollars in damages to recreational boats occur each season.

Many species of fishes, such as the Bluntnose Minnow (Pimephales notatus), Fathead Minnow (Pimephales p. promelas) and several species of catfishes use these objects as substrates to deposit their eggs. At times, the litter may be the only available spawning substrate or cover. It is possible that in certain areas the litter is responsible for the productivity of certain species.

During the floods, however, much of this debris is moved downstream, carrying the spawn into the lake or lower river. Often the eggs are destroyed or the larvae hatch into unfavorable environments. We have observed that the Yellow Perch deposits strings of eggs on mops, rugs, pieces of plastic, paper, wire and discarded Christmas trees. As this debris moves throughout the lake, the eggs become dislodged and fall to the silted bottom where they fail to hatch. Often the debris

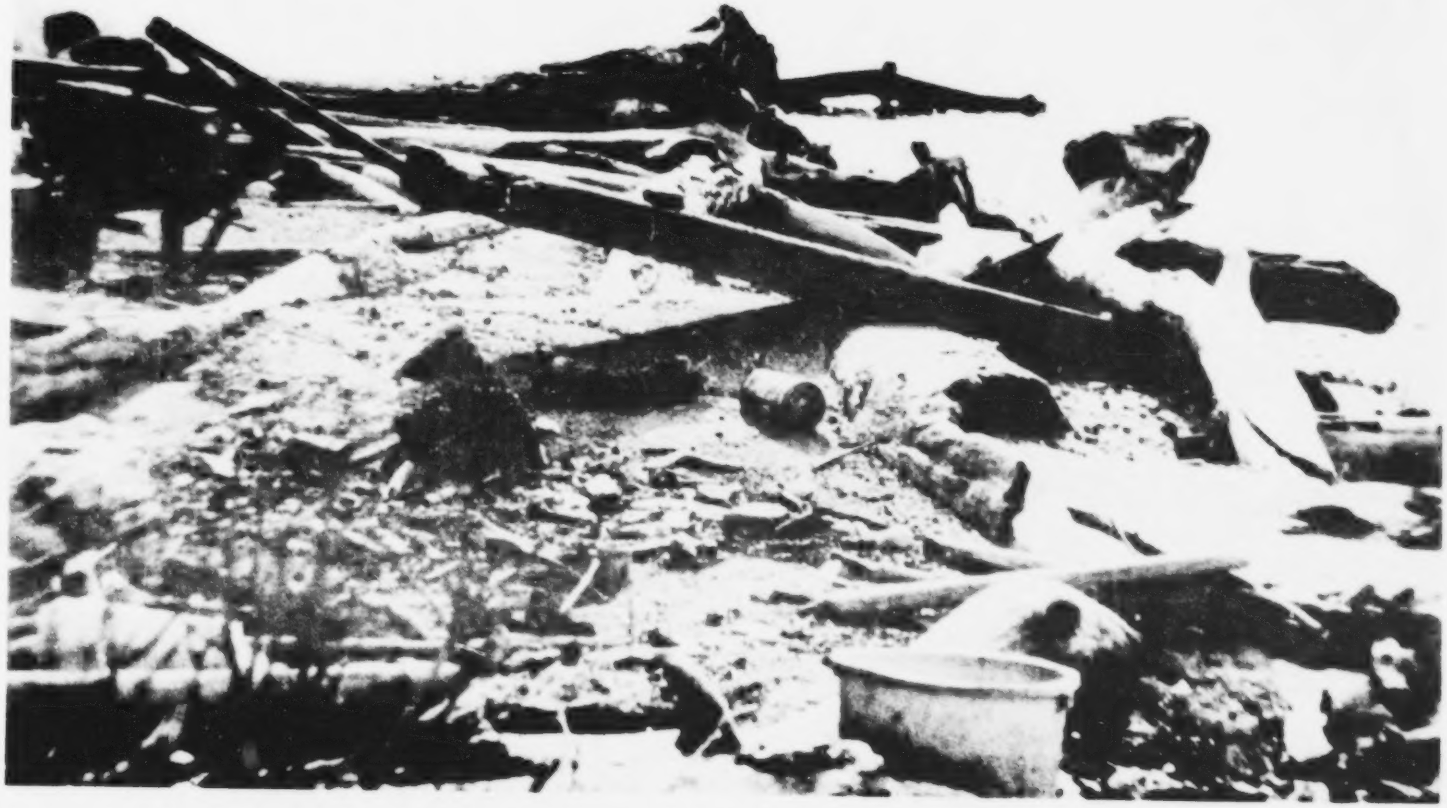

Figure 2: Litter Present on Beaches Near Cleveland, Ohio.

carrying the eggs drifts far from shore where the larvae, upon hatching, may be unable to find suitable food and subsequently perish.

Exploitation of Fish Populations

It is patently obvious that exploitation of fishery resources, through commercial and/or sport fishing, must have an effect on certain fish populations to a greater or lesser degree. The literature is replete with instances of over-fishing, especially during that period when a fish population is concentrated in a small area, such as on its spawning ground. It appears to us that over-fishing, commercially or otherwise, has been greatly over-rated in many instances and that most species can be over-fished only through maximum and continued effort. It is our belief that had not a single muskellunge or sturgeon been removed directly by man, the present populations of these species would not be noticeably greater in Lake Erie. It was the destruction of one or more factors in their life history, such as of their spawning areas, that resulted in marked decreases in the size of a given fish population or has actually endangered many species in Lake Erie. It long has been the custom for the gill netter to blame the trap netter for the decrease of a fish population, or for the sport fisherman to blame both. The destruction of one or more environmental factors necessary to the completion of a fish's life history adversely affects the production of young or adults and is the more significant contributor to its decline.

An excellent example is the Smallmouth Blackbass. In 1830, the species was heavily fished around the Bass Islands of Lake Erie by both sport and commercial fishermen. The normal catch of several hundred bass per day were reported by sportsmen, and as late as 1877, several tons of Blackbass were taken daily in the vicinity of the islands by hook and line. During this period, Sterling (142) bitterly complained that the sport fishermen were rapidly depleting the Blackbass population and that catches of 750 per day by single individuals was not uncommon.

The population began declining rapidly after 1885. In 1902, the commercial catch and sale of all species of Blackbasses was prohibited. It was public opinion that removal of commercial exploitation would result in the immediate restoration of the population to its former abundance.

The population continued to decline, and several years later restrictions were placed on the sport catching of Blackbasses. Despite increased restrictions, Lake Erie populations of Blackbass continues to dwindle. After more than 70 years of protection from both commercial and sport exploitation the Smallmouth populations have continued to decline. Sport catching near the Bass Islands is presently limited to only a few specimens daily and the species has been extripated from much of the remainder of the South Shore of Lake Erie.

Introduction of Exotic Species

Exotic or non-native species of fishes may become established in a body of water by several methods. Often efforts are made by man to introduce fish species to augment the existing fishery. Trautman (147) states that more than 17 species of non-native fishes have been introduced into Ohio waters for this purpose. Normally, the introduction of such species is unsuccessful. Unfortunately, some species which have become firmly established have in time also become largely unwanted, as have the Carp and Goldfish.

Occasionally, species are inadvertently introduced by sportsmen through their use of minnows as fishing bait. Often these minnows are imported, and their release into Ohio waters may establish a reproductive population. This may have been the case with the Fathead Minnow in many Ohio streams.

Species have also invaded Ohio waters through man-made waterways, such as the Welland Canal. These species (e.g. Sea Lamprey, Petromyzon marinus) have been largely undesirable.

Exotic species compete in the ecosystem for space and food, and may adversely affect native species ability to survive. Often the exotics are major predators, feeding heavily on the native fauna, while having less sport or commercial value than the native predators which they displace.

The introduction of exotic species is often hailed as the ultimate answer to a problem of environmental degredation. It is believed that exotics will survive in an eroding environment where native fishes have drastically declined. Some species, (Coho Salmon, Oncorhynchus kisutch) are of outstanding food value in their native habitat, whereas, when introduced into Lake Erie they become far less desirable than the species they apparently were intended to replace (Blue Pike, Stizostedion v. glaucum).

Environmental restoration would be a more reasonable, less costly and a more permanent method of establishing high populations of food species. It seems more logical to attempt to restore the former abundance of Smallmouth Blackbass, Walleye or Northern Pike than to continue the expense of random introductions or "replacements" for the native fauna, hoping for success.

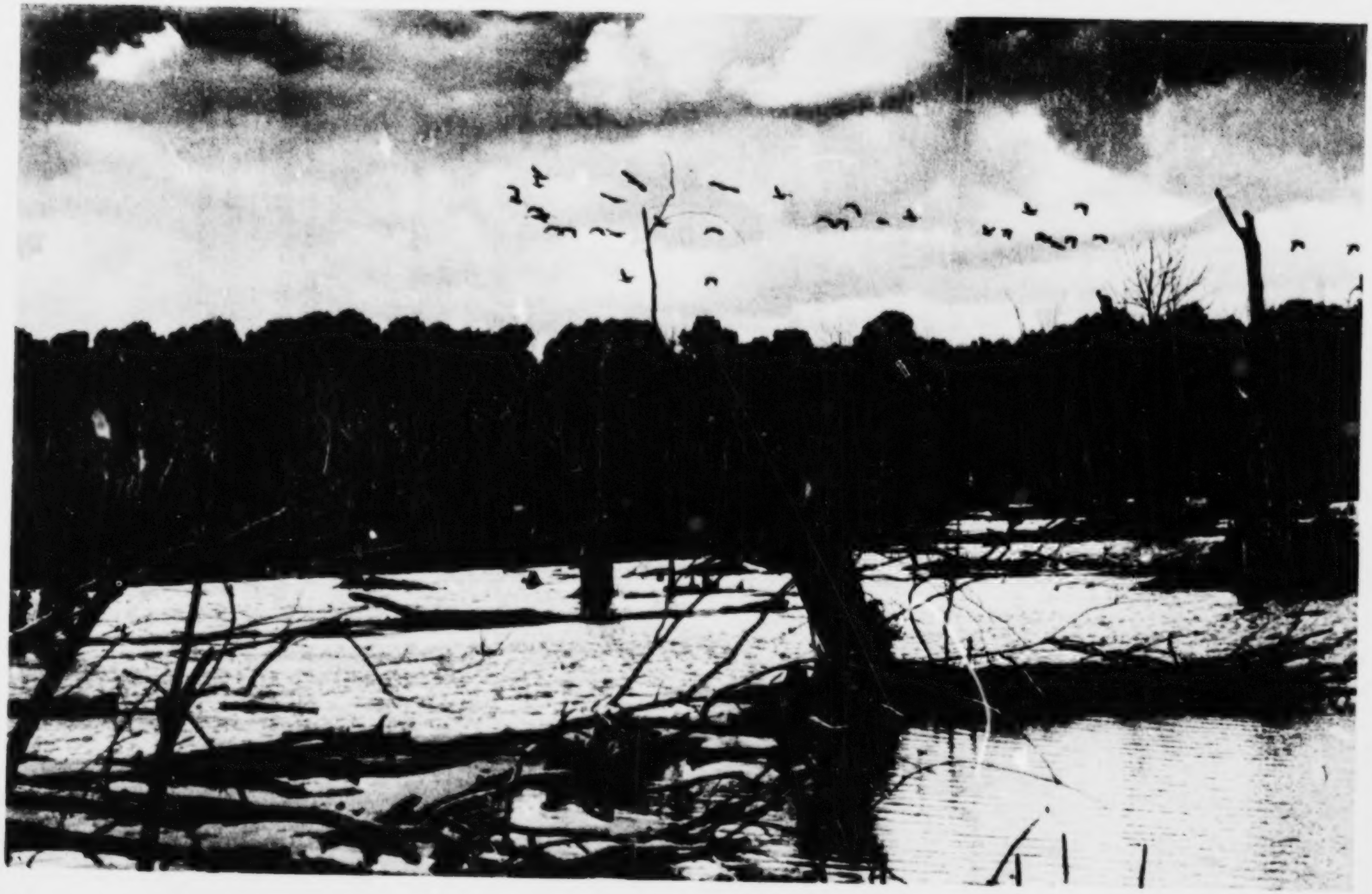

Figure 3: Undisturbed Wild Area Similar to That Described by Early Surveyors Along the Lower Cuyahoga and the Lake Erie Shoreline. This area is in the Upper Cuyahoga.
(Photo by Mark Caroots)

SECTION IV

HISTORICAL REVIEW OF THE CLEVELAND AREA FISHERY

A survey of the literature concerning the study area indicated that a total of 107 species and subspecies of fishes had been reported by previous investigations to have at one time inhabited the Cleveland Metropolitan Area. These comprised a total species list regarding the fishes of the Cleveland shoreline and the three river drainages. (See p. 48-132). The only available literature pertaining to the fish fauna of this area within the past twenty years are the reports of Orr (1968), Havers and Emerson (1969, 1971) and the annual reports of the Ohio Division of Wildlife. Orr's work is concerned only with the upper one-third of the Cuyahoga River drainage. The Ohio Division of Wildlife gill net surveys include only one Cleveland sampling station (comparable to our station 3); and the reports of Havens and Emerson comprised what we deemed to be an inadequate and inaccurate investigation of the abundance and distribution of fishes of the three river drainages. These latter investigators collected only thirteen species of fishes from the Chagrin River while our cursory investigations yielded 78 species. In addition, it has been stated that the Lake Erie and especially the Cleveland area is virtually fishless. For example, a college level biology laboratory manual (1971) stated:

> "Nobody was paying close enough attention to tell when it happened, but a few years ago most of Lake Erie died; solid wastes along with acid and other poisons have left much of its water void of life except for sludge worms and a few mutant carp that have adjusted to conditions."

Such inferences and statements have been refuted by the findings of this investigation.

It is apparent that a detailed, accurate baseline of data for the fishes of the shoreline and the three river systems in the Cleveland area is unavailable. Such a baseline, when achieved, would be meaningless unless compared with distribution and abundance of fishes in the past. An exhaustive literature survey covering the period from 1790 to 1972 was undertaken, to define the chronological changes of the Cleveland Metropolitan Shoreline and adjacent tributaries regarding fish populations and water quality.

Original Water Quality and Fishery

The first surveyors and settlers who reached the Cleveland area did not leave verbose accounts of its fauna, although we have a rather complete account of the forests. From the few existing reports and scattered information from journals and diaries of the pioneers, it is possible to obtain some concept of Cleveland during this early period.

Published references indicate that the Cuyahoga, Chagrin and to a lesser extent, the Rocky rivers, originally were composed of a continuing series of riffles and deep pools. The substrates consisted primarily of clean sands and gravels with areas of scoured bedrock and boulders. All streams were largely covered by a forest canopy; the waters cool, clear and free of turbidity. The statements of many early writers testify to the clarity and purity of the waters of the Cuyahoga. Early surveyors drank directly from the river, and the City of Cleveland utilized it as a source of drinking water until the 1850's. Kirtland stated that in 1844, the Brook Trout was present in area streams, this attesting to their clarity and coolness.

The upper and lower sections of all three river drainages contained profuse quantities of aquatic vegetation, in the streams and adjacent swamps. Near the mouth of the Cuyahoga (presently the industrial "flats" of Cleveland), there was an immense marsh. The upper section of the Cuyahoga was also largely wetland. Concering this section, Seth Pease, a member of Moses Cleaveland's survey party (1797) wrote in his journal that they were, "...much troubled with ponds and swamps." (127), (Fig. 3).

The shoreline of Lake Erie in the Cleveland area was quite different than it is today. Holley (48) another member of Cleaveland's survey party, wrote in his journal that:

> "East of the Cuyahoga River a rock shore begins and continues nearly a mile, then a good beach commences and continues to the Chagrin River."

Apparently this beach was of considerable size because a survey party of nearly 40 men maintained a base camp on it.

Originally, the Cleveland area was densely forested and contained a sizable population of game animals. Early surveyors and settlers routinely captured such mammals as elk, deer, bear and smaller animals as passenger pigeons, turkeys and squirrels. According to Whittlesey (160), Hamilton stated in his 1797 journal that:

> "...we discovered a bear swimming across the river [Chagrin]. Porter and myself jumped into a canoe and paddled after him, while another man went with a gun up to the shore."

Rattlesnakes were apparently numerous, and were sometimes eaten as a delicacy (160).

The rivers and streams were heavily populated with wildlife. Although no exact records exist concerning the abundance of fishes in the

Cleveland area, it is the opinion of Mrs. Virginia Howley, of the Western Reserve Historical Society, that the reason for this was that fish were so commonplace and ubiquitous that they were largely deemed unworthy of mention in the journals (51). The occasional records of soldiers and woodsmen elsewhere in Ohio, indicate that there was an immense population of fishes (147). This condition can be assumed to be representative of the Cleveland area also.

Hildreth (39), for example, stated that the indians could travel long distances by canoe because the waters

> "...afforded them a constant magazine of food."

because of the vast multitude of fishes. Trautman (147, p. 17), in discussing the great abundance of fishes in Ohio before 1800 quoted that Bradly constructed a brush fish trap across the Miami River near Hamilton, Ohio. This trap, in one night, caught 2500 pounds of fish, and about the same number on the next night. Also that Brown, in discussing fishes in the Maumee River near Toledo, Ohio, stated that their numbers were "almost incredible". He further stated that,

> "...[fish were] so numerous...at this place, that a spear may be thrown into the water at random and will rarely miss killing one!"

Kirtland, several times indicated similar abundances of fishes in the Cuyahoga River between 1840 and 1855.

It should be noted that in these early days, the species composition differed markedly from the present. Carp and Goldfish had not yet been introduced into Lake Erie and the Gizzard Shad was not abundant. It was the large, fine food species that were abundant. These species, such as Lake Sturgeon, Lake Muskellunge, Northern Pike, Smallmouth Blackbass, Walleye and numerous species of redhorses (Moxostoma spp.) flourished in the clean unpolluted lake, streams and marshlands.

The Cleveland area fauna of 1797 persisted until at least 1820 although a slight decline was evident. Charles Whittlesey (160) wrote that a member of Cleaveland's survey party of 1797 had revisited the Cleveland area in 1820, and found that the Cuyahoga River was virtually unchanged from what he had originally observed.

Changes Between 1820 and 1855

By 1820 nearly every stream and river in the Cleveland Metropolitan Area was blocked by mill dams. These dams affected many species of fishes in various ways, as indicated by the early decline of several species. The first result was the drastic decline of the Lake Muskellunge and Northern Pike populations. Unable to reach the upstream marshlands because of dams, they were unable to spawn. Likewise, the stream spawning populations of Lake Sturgeon also declined although populations of adults persisted for years because this fish is particularly long-lived (probably over 100 years), and because during this period, it had little commercial value.

The Cleveland area was fortunate in having during the 1820-1850 period one of Ohio's outstanding naturalists, Jared Potter Kirtland. This man left for posterity a highly accurate account of fish populations in Ohio and especially in the Cleveland area, in his writings published primarily in the Boston Society of Natural History and in the Family Visitor (for bibliography of Kirtland, see Trautman (147), pp. 628-630). Kirtland, in 1850, pointed out the drastic modifications in the fish fauna during this period. He stated,

> "still greater changes if possible have occurred with the finny tribes. The sturgeon has nearly forsaken this [south] shore of the Lake..."

He further stated:

> "all the migratory species have been excluded... by the construction of dams..."

While Kirtland (91) deplored the decrease of Muskellunge and Pikes, he pointed out that in the same year one could capture near the present Cleveland harbor as many as 100 bass and Walleye in a morning by hook and line and that,

> "Between 1849-51 the waters of Lake Erie near the mouth of the Cuyahoga River was literally black with fishing boats."

Other species, such as the Smallmouth Blackbass and Walleye did not undergo a drastic reduction during this period because of the spawning and nursery areas available along the shoreline. Unfortunately, however, the Cleveland region does not contain the abundance of reefs and shallow water spawning sites that occurred to the west in the vicinity of the Bass Islands, and as shall be seen, these populations of shoreline species were to be severely affected after 1850.

In addition to the early effect of mill dams, the water quality in the Cleveland area also changed notably after 1820. The deterioration of water quality increased with the increase in human population and industrialization. In 1820, the population of Cleveland was approximately 150 persons, and as has been previously stated, the river was relatively unpolluted. Soon after the opening of the Ohio Canal, industrial activity was accelerated and by 1855 the population of Cleveland was

26,000 (145). Municipal and industrial pollutant input was greatly accelerated, leading to the total degradation of the Cuyahoga River.

By 1840, industrial pollutants, such as coal dust, iron ore, sawdust and others had greatly deteriorated the quality of the lower Cuyahoga. In 1851, a report on the water quality of the Cuyahoga was submitted to the Ohio State Medical Convention. It stated that,

> "...contaminated drinking water taken from the Cuyahoga is responsible for the wide prevalence of Typhoid Fever."

Obviously, this was the result of increased domestic sewage in the lower river.

Kirtland was appointed to a commission to relocate the Cleveland water intake. He was insistent that the intake tunnel be located in the Lake, at a point where prevailing winds would not carry sewage contaminants to the water intake. In 1854 a new intake was constructed 400 feet offshore in Lake Erie. By the end of this period, it was apparent that the lakeshore was relatively clean, with high populations of many species of fishes; while the lower Cuyahoga had become an open sewer, full of industrial and municipal wastes.

Changes Between 1855 and 1900

Industrial pollution increased so that by 1868, the Cleveland Daily Plain Dealer reported that:

> "...from the filthy looking conditions of the river, we imagine that but a short time will be required to remove all evidences of beauty and cleanliness from there. We should think there might be some way discovered by which the filthy refuse of the oil refineries could be disposed of in some other way, than by emptying it into the river."
> (Vol. XXIV #110, May 6, 1868, p. 3)

During the winter of 1869 petroleum wastes were reported to have contaminated the waters of Lake Erie from bottom to surface for a distance of one mile from shore. This total deterioration of water quality in the Cuyahoga River was now having an adverse effect on the near-shore waters of Lake Erie. Numerous reports in newspapers of the 1860's told of "rescuing" fishes from near the mouth of the Cuyahoga River. About this time, open Lake species began to avoid the polluted near-shore areas of Cleveland.

In 1859, Garlick (35) had reported that:

> "Owing to the scarcity of fish on our coast last fall [Whitefish] eggs will be ready for planting in Lake Erie."

Apparently, the reason for the decline of Whitefish (Coregonus clupeaformis) along the near-shore areas was their avoidance of Cleveland pollution, since good catches of the species were still being made elsewhere in Lake Erie.

Soon after 1870, local newspapers carried increasing numbers of advertisements for Smallmouth Blackbass fishing excursions to the Lake Erie Islands. Since Kirtland had reported large populations of Blackbasses in Cleveland during the 1850's, it is apparent that the populations along the shoreline had declined drastically within 20 years. Obviously, other shoreline species (eg shiners, minnows, darters) were also adversely affected by the industrial and municipal pollutants.

Further documentation of the increased effect of the river pollution on Lake Erie is evidenced by the construction, in 1875, of a new water intake for the City of Cleveland. This time it was located 6,200 feet offshore, where uncontaminated waters were still available. This new source of water was not to be uncontaminated for long, however, for in 1882 the City experienced its first problem with algal blooms which contaminated the water collected from the new source. A report on the problem stated that prior to this year (1882), the City had been exempt from this problem.

In 1890, the construction of the Cleveland Sewer System effectively collected municipal wastes from the City, and emptied them, untreated, into the Cuyahoga River. This final act of the 1800's must have had an adverse effect on the already decimated Smallmouth Blackbass and Walleye populations along the near-shore areas of Cleveland.

The Lake Sturgeon population continued to decline after 1855, because of a lack of reproduction. This decline was then accelerated by commercial exploitation. By 1917, the Sturgeon had declined to such a low level that only 128 lbs. (probably one or two fish) were landed by the combined effort of 63 commercial vessels fishing from Cuyahoga County (40).

From the above discussion, it is apparent that the deterioration of fish populations and water quality were occurring simultaneously. By 1900, the combined effects of physical obstructions, draining, siltation, and the municipal and industrial wastes had nearly extirpated most fish species along the near-shore areas of Lake Erie in the vicinity of the Cuyahoga River. Apparently, the lower Cuyahoga itself was devoid of fish life.

The popular opinion of the general public is that the decline of fish populations in the Cleveland area of Lake Erie is of recent origin. This is simply not so. The actual decline in population size of some species of fishes began before 1820. By 1850 many local populations had become drastically reduced. By 1900 the populations of many species were on the verge of extirpation. Certain species such as the Muskellunge, Channel Darter (Percina copelandi), Sand Darter, Pugnose Minnow and Smallmouth Blackbass had almost disappeared from the area near Cleveland.

The production of fishes from the river drainages and the near-shore areas of Lake Erie had become critically low.

By 1900, two species of fishes had been extirpated from all of Lake Erie, the Popeye Shiner (Notropis ariommus) and the Gilt Darter Percina evides). In the Cleveland area, many species were already extirpated, such as the Spotted Gar (Lepisosteus oculatus), Bigmouth Buffalofish (Ictobius cyprinellus), Flathead Catfish (Pylodictus olivaris), Tadpole Madtom (Noturus gyrinus) and Longear Sunfish (Lepomis megalotis peltastes).

Changes Between 1900 and 1970

Between 1900 and 1970, there was a continued decline in abundance of several of the remaining species. Others, such as Carp (Cyprinus carpio) and Goldfish (Carassius auratus) had been introduced and were becoming increasingly abundant. Rainbow Smelt (Osmerus mordax) had gained access to Lake Erie by 1936 and was increasing in abundance. The Eastern Gizzard Shad (Dorosoma cepedianum) was rapidly replacing the waning populations of the Mooneye (Hiodon tergisus).

Hartman (37) adequately describes the trends of valuable food species during this period. He states:

> "...since 1925, the fisheries for lake herring, lake whitefish, sauger and blue pike have also disappeared. Today the important walleye population is exhibiting highly variable year-class success from year to year.
>
> In place of those lost resources, other species have thrived or even had explosive abundance. Sizable population of medium-value yellow perch, white bass, and channel catfish still exist in the lake. But the fish business is becoming more strongly dominated by such lower-valued species as carp, smelt, and fresh-water drum."

A similar decline of non-food species has also occurred, and in many instances the number of species involved is much greater.

At present, the Cleveland area may be seen to exhibit almost every possible situation which would adversely affect fish populations. Dams are present in every river drainage, often near the river mouth; chemical pollution is at such a critical level that the Cuyahoga River occasionally catches fire. Municipal pollutants have caused most area beaches to be closed (except for those which are enclosed and chlorinated), and in some areas the organic material makes low dissolved oxygen levels commonplace. Siltation is a major problem, and dredging is essential for the passage of ships, yet land use practices enhance erosion and channelization proposals continue to be considered. Forest canopy, which formerly shaded the streams is almost non-existent and most streams are warm and turbid. The formerly abundant aquatic vegetation has nearly disappeared and swamps have been replaced by homes and factories. Shoreline marshes are either being drained, filled or contaminated with industrial wastes (eg salt, oil, etc.). Chemical and thermal discharges of the Cuyahoga River and lakeshore at times results in fish kills. (Tables 1,2).

Spawning grounds for nearly all species of fishes have either been covered by silts, been made inaccessible by both physical or "chemical" obstructions, or been drained. At this point in time, nearly 50% of the former fish fauna of the Cleveland Metropolitan Area are extirpated, endangered or rare.

It is important to note that the destruction of the Greater Cleveland fisheries was a gradual process, beginning after 1830. We have already indicated that many of our native species were nearly extirpated by 1850 (Muskellunge), others by 1900 (Sturgeon) and still others (Blue Pike, Burbot) by 1960.

It is more important to realize that almost all of the species of fishes, formerly inhabiting the Cleveland Metropolitan Area, are still present, even though in limited numbers. The generally accepted attitude that only Carp, Drum (Sheepshead, Aplodinotus grunniens) and Yellow Perch are present in the Cleveland Lake Erie area is erroneous. It is our opinion that should the water quality and the environmental requirements of fishes be restored, the populations and diversity of fishes would recover in a few years. We believe that many species are in a very precarious position at this time, and that it is essential that the Cleveland area water quality and habitat be restored quickly. Otherwise, we predict that the several additional species will become extirpated from the area within the next few years.

Since the results of this report indicate that the fish fauna of the Cleveland Metropolitan area can be restored, it is imperative that attempts to accomplish this task be undertaken. In an area such as the Cuyahoga River or Cleveland Harbor, where current attitude is

Table 1 : Chloride Levels of some Lake Erie Tributaries in 1904
(mg/l)

(from Volume I)

Location	Date	Chloride
Detroit River, South of Grosse Ile	July 12, 1904	3.00
Maumee River, near the mouth	August 27, 1904	24.60
Portage River, Woodville, Ohio	September 11, 1904	23,240.00
Sandusky River, near Tiffin, Ohio	September 11, 1904	410.00

Table 2: Loadings to Lake Erie via the Cleveland Harbor and Cuyahoga River Dredgings from July 1, 1966 to July 1, 1967.

(from Volume I)

(Quantities expressed in tons)

Constituent	From River	From Harbor	Total Amounts
COD	110,000	19,000	129,000
BOD_5	7,100	1,000	8,100
Chlorine Demand (15 minutes)	14,000	2,400	16,400
Volatile Solids	58,000	13,000	71,400
Oils and Greases	16,000	1,600	17,600
Phosphorus	1,860	300	2,160
Nitrogen	2,300	320	2.620
Iron	51,000	9,000	60,000
Silica	270,000	140,000	410,000
Total Dry Solids	460,000	200,000	660,000

that no fishes are present, the restoration of fish populations would be a striking example of pollution abatement and restoration within the City. Such an accomplishment would be of significance to the area, the State and the Nation.

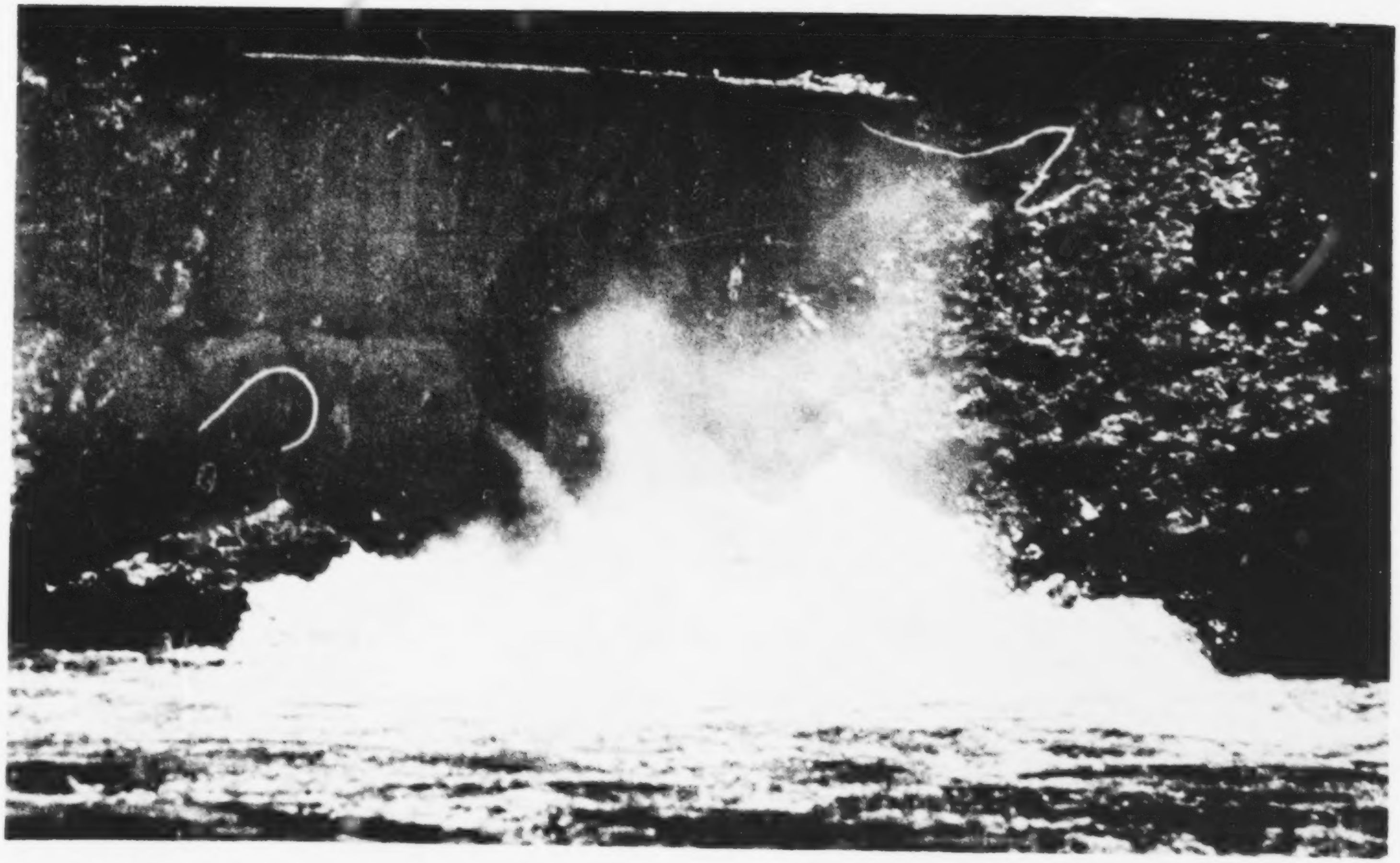

Figure 4: Effluent into a Stream Tributary of Lake Erie

Hot water effluents in upper sections of Lake Erie tributary streams often contain chemical pollutants in addition to heat. Tributary waters are warmed and many species are killed during winter and spring in large numbers.

SECTION V

METHODOLOGY OF DATA ACQUISITION

LITERATURE SEARCH

To determine the historical changes in both the distribution and abundance of each species of fish inhabiting the Cleveland Metropolitan area, an intensive literature search was undertaken. The past conditions of the Cleveland fish fauna was documented in several ways. Many historical documents were utilized, these from the collections of the Western Reserve Historical Society, the Cleveland Museum of Natural History Library and others. These included the field notes of several members of the Moses Cleaveland Survey Party(1797-1798), local newspapers of the 1800's, publications of scientists of the early era such as Rafinesque and J. P. Kirtland, and the field notes of 20th Century scientists such as Milton B. Trautman.

Certain of the information concerning the early fauna of the area was interpolated from the writings of the early pioneers, surveyors and naturalists of the early 1800's who wrote of the conditions elsewhere in Ohio. This information, often concerning streams and areas of Lake Erie adjacent to the study area, was utilized in the historical discussion contained in Section VI of this publication.

More recent information was gathered from publications, the records of commercial fishermen, unpublished manuscripts and theses, and the collections of local museums and Universities. Discussions with local fishermen and residents were also helpful in determining the recent changes which had occurred with the distribution and abundance of the fish fauna.

More than 500 documents pertaining to the region or individual members of the fauna were utilized during the literature search. Several hundred of these are presently filed at the John Carroll University, Department of Biology and/or The Sears Library, Case-Western Reserve University. Approximately 160 of these are cited in this publication.

FIELD COLLECTIONS

The field collections were conducted in the nearshore areas of Lake Erie, and in the drainages of the Rocky, Chagrin and Cuyahoga rivers. During the period from June 1, 1971 through December 31, 1972, more than 200 collections were made at various sites, some of which were sampled repeatedly. A variety of techniques were used, often several at a site during a single collection. Over 77,000 specimens of fishes were collected and examined. All except approximately 7,000 were subsequently released.

Specimens of each species collected were preserved and placed in the John Carroll University Museum, Vertebrate Collections or in The Ohio State University, Museum of Zoology. These specimens will serve to be a permanent record of the species present during the study and shall be maintained for reference or study by other investigators. The John Carroll Collections are maintained by Dr. Andrew M. White, Biology Department, and the Ohio State collections are under the direction of Dr. Ted Cavender, Zoology Department.

Sampling Techniques

Samples were taken in the deeper waters employing an 18-1/2 foot outboard motorboat, the "Noturus". In deeper areas of the lower river drainages, rowboats were often utilized. During periods of heavy seas, especially during the winter, a chartered commercial fishing vessel was used. In order to insure that the greatest variety of fishes were collected, several sampling techniques were utilized, depending upon the conditions at the sample site. Often, more than one technique was employed during a collection. These various techniques are described as follows:

1. Gill Nets

   Experimental gill nets were used in the open Lake, the deeper portions near the shoreline, and in the lower sections of the river drainages. These nets were 125 feet in length, 6 feet in depth, and consisted of five panels of varied stretch mesh sizes (1 in., 1-1/2 in., 2 in., 3 in., 4 in.).

   Stations were sampled with experimental gill nets for periods of 24 to 48 hours. In some cases, additional gill nets were utilized, these having stretch mesh sizes of 2, 2-3/4, 3-1/2, 4-1/2, 5, 6, 8, 10 or 12 inch stretch. As these larger sizes were not used routinely in the sampling procedure, the fishes collected by these nets were included only in the distribution data and have been disregarded in the evaluation of relative abundance and species diversity.

   It was difficult to sample in the shallow waters of the Lake and lower rivers due to the interference on the part of recreational boaters and sport fishermen. The gill nets therefore, were always set between 0-7 feet from the bottom, and at least 10 feet below the surface. Occasional samples

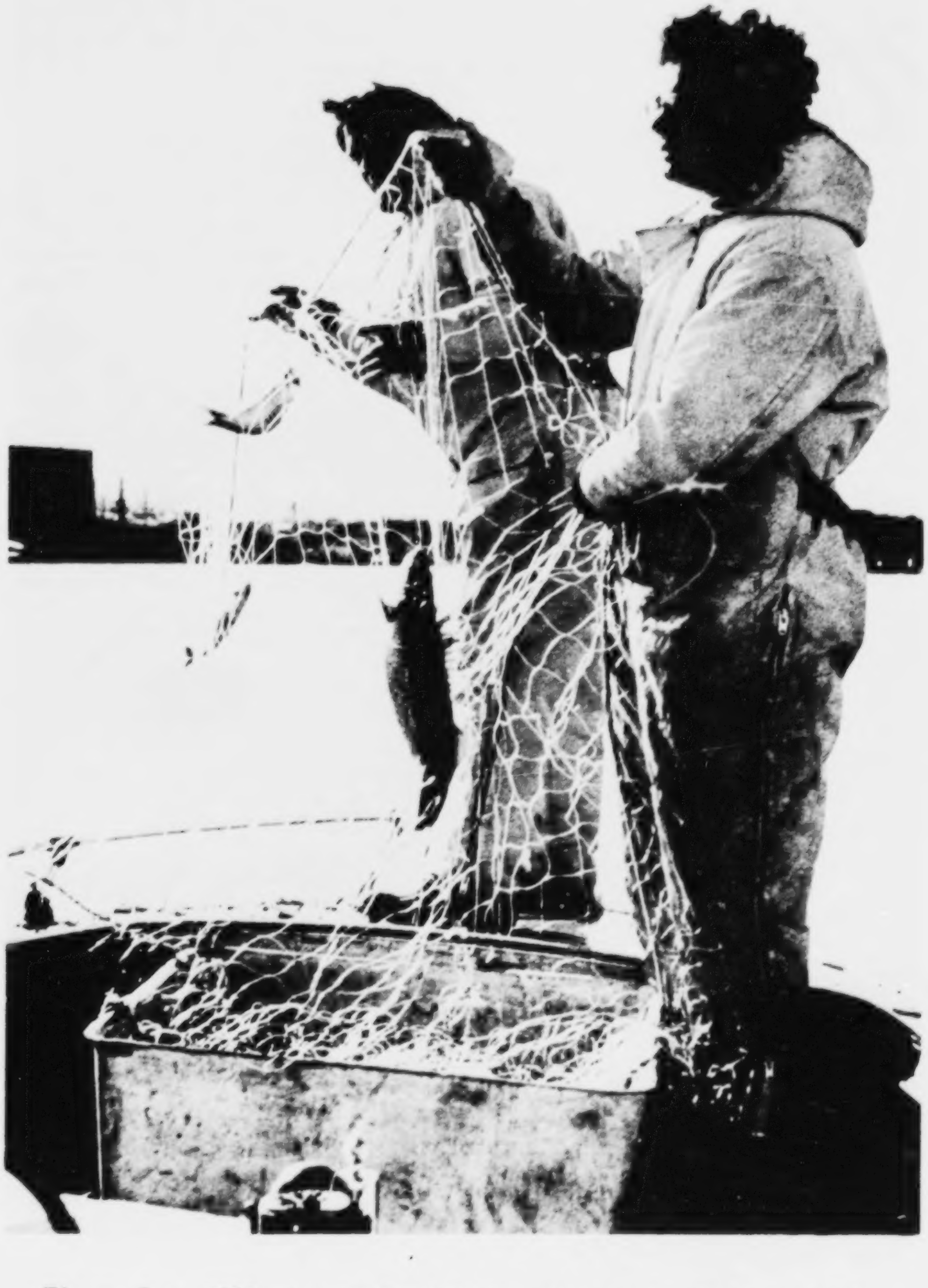

Figure 5 : Gill net samples being collected in the Cleveland Harbor during January.

were taken in these areas by setting nets for short periods in the early morning hours or at night. Crews would then remain with the nets insuring that fishermen or boaters did not become entangled.

A considerable number of samples in the upper and middle portions of the rivers were taken with the aid of short (125') gill nets. Often large pools were sampled by placing one of these nets across the pool, and then swimming in the pool in order to frighten the fishes into the net. In this manner, several species were collected that were extremely difficult to capture by other methods.

Many samples were not included in the data concerning the relative abundance and some were completely disregarded as representative since high winds and storms frequently filled the nets with trash and debris. This often caused the nets to roll and collapse; or tore large holes in the gill net, thereby reducing its efficiency.

2. Trawling

Trawling samples were taken in order to collect species that were either too small to capture with the gill nets or were not readily collected by that technique. Trawling was difficult to accomplish in the study area, especially in lower rivers and the Cleveland Harbor, because of the great quantity of rocks, trash and debris on the bottom. A limited amount of trawling was accomplished and this information is included in the distribution data only, since most attempts at these collections were considered to be unrepresentative.

The trawl utilized in the collection of this data was a 16 foot semiballoon otter trawl equipped with mud rollers.

3. Fyke Nets

Fyke nets were utilized on a limited basis due to the heavy use of the study area by recreational boaters and sport fishermen. Tampering, theft and boating accidents due to the obstruction of waterways invalidated most of the samples. The possibility of boating accidents would have created a public relations problem in many areas. Fishes collected by the Fyke nets are included in the distribution data only.

Fyke nets were successfully used in certain areas of the upper and middle portions of rivers, and in these cases the nets were set for periods of 24 hours. The nets consisted of 4 foot hoops and twenty foot wings. The mesh was of 1/2 inch stretch mesh.

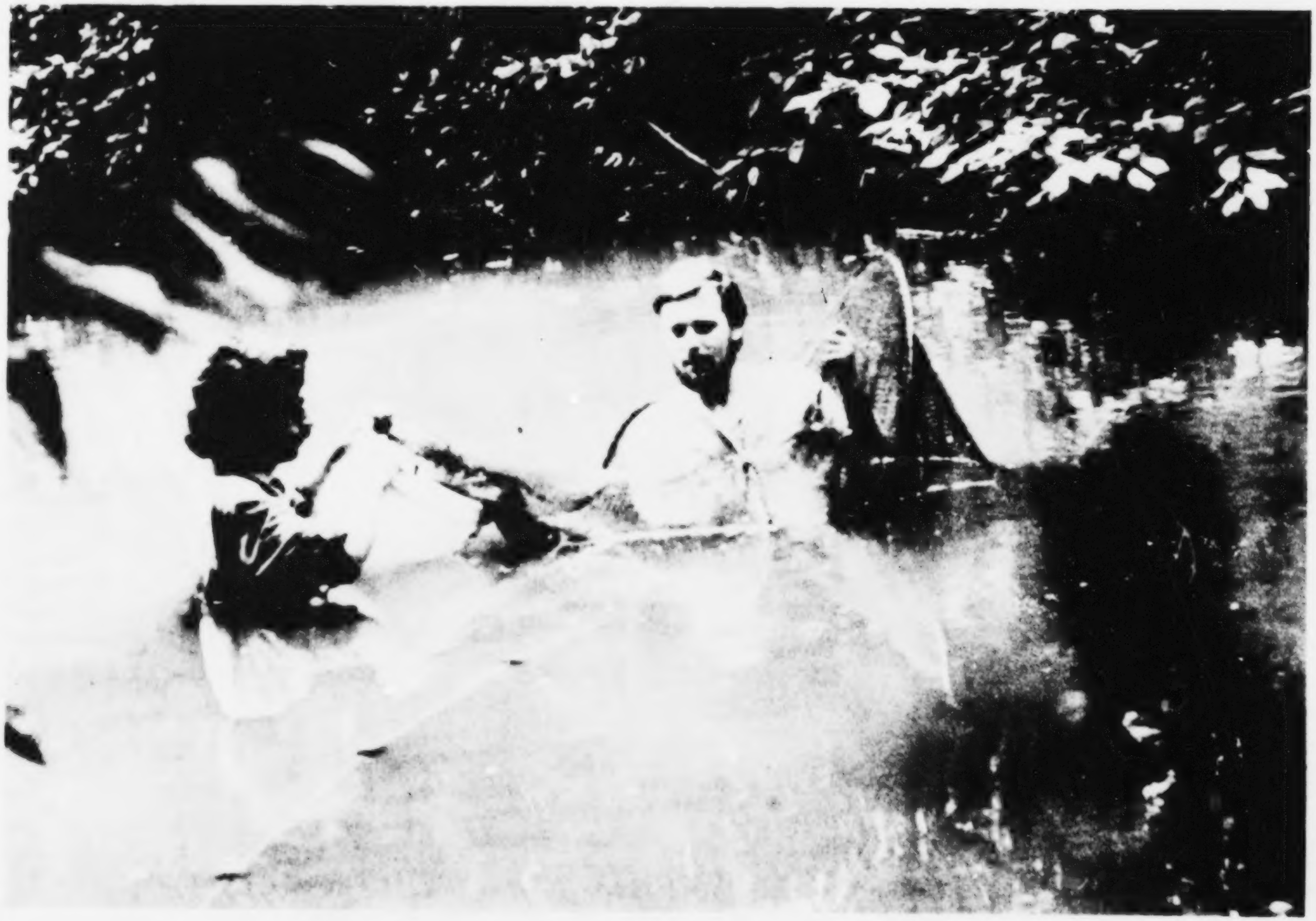

Figure 6: Fyke Net Sample Being Collected in a Pool in a Tributary Stream.

4. Seining

The shallow beaches along the Lake Erie shoreline and shallow areas within the marinas and harbors were sampled with seines and a crew of four men.

In the river drainages, seining was the most effective method of collection, and was utilized extensively. Seining in the streams was accomplished using three man crews. All available habitats were sampled within 1/2 mile areas both upstream and downstream of the station. Depending upon the characteristics of the area, a variety of seines were utilized. These included the following:

A. A 50 foot, 1/2 inch mesh seine with a 4 X 4 foot bag. The seine is 4 feet high.

B. A 26 foot, 1/4 inch mesh seine with a 4 X 4 foot bag. The seine is 4 feet high.

C. A 16 foot, 1/4 inch mesh seine with a 4 X 4 foot bag. The seine is 4 feet high.

D. An 8 foot Common Sense seine, 4 feet high with 1/4 inch mesh.

E. A 4 X 4 foot fry net with 1/16 inch mesh. This seine constructed of "Ace" netting.

Of the fishes collected by seining, approximately 95% were identified at the collection site and then returned to the stream. The remainder were placed into a solution of 6% formalin and returned to the laboratory for confirmation and to be used as representative specimens.

5. Sport and Commercial Catches

No attempt was made to actively survey the catch of either sport or commercial fishermen. In some localities however, certain species were observed only in these catches. These data have been included in the distribution of species and are not incorporated into the relative abundance data. At times, only persons engaged in these activities observed some species. These reports were considered valid only when supported by a clear, dated photograph or the specimen itself (or portions of the specimen which could identify it to species).

The records of the Cleveland area commercial catch and the Ohio Division of Wildlife gill net surveys have been considered

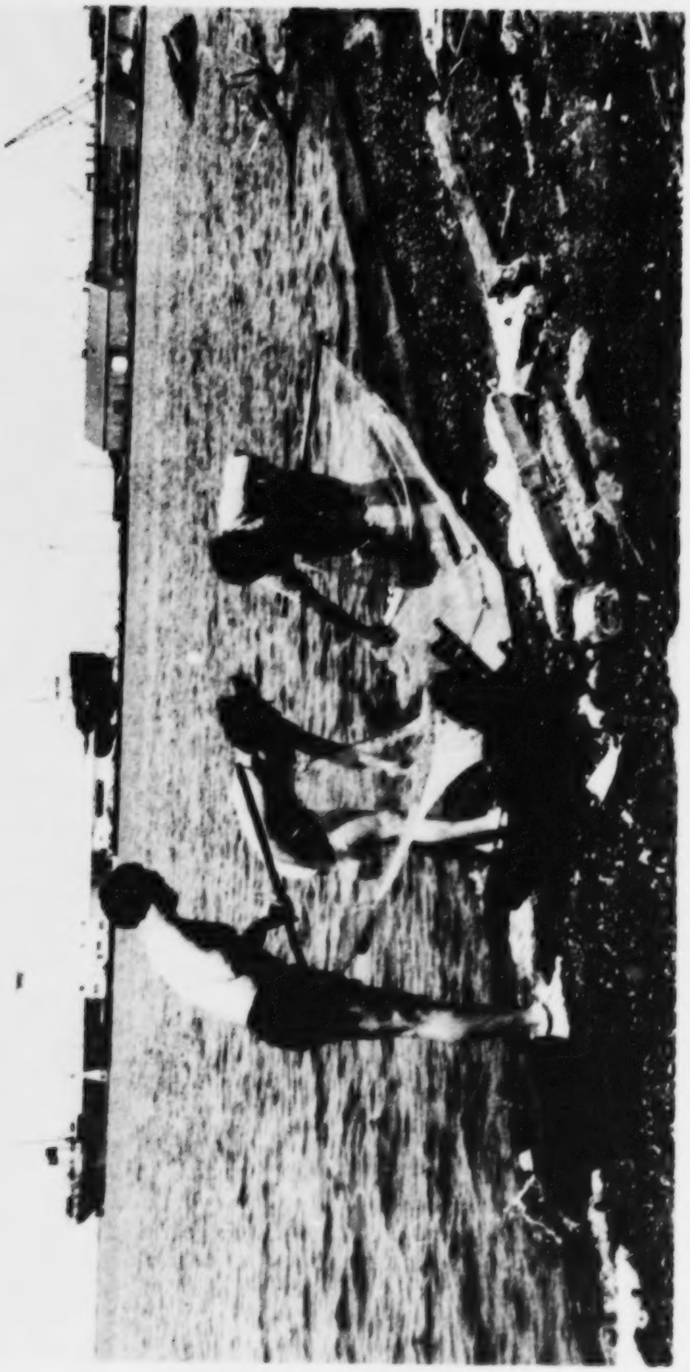

Figure 7: Seining in the Cleveland Harbor Shallows.

valid and have been utilized as a source of recent data.

6. Direct Observations

Observations of fishes without supporting collections were, in almost every case, considered to be invalid. Only the observation of a species having unique characteristics was accepted, and then only if reported by a reliable observer. Such species as the Longnose Gar were accepted while species such as the Common Emerald Shiner, Bluegill Sunfish or White Sucker were not accepted unless substantiated by a specimen.

LABORATORY TECHNIQUES AND METHODOLOGY

Coefficient of Condition

Fishes utilized in the calculation of the Coefficient of Condition (K) were collected and then returned to the laboratory on ice. The specimens were weighed as soon as they reached the laboratory. Weights were taken with a Mettler Balance, and were recorded to the nearest gram.

Lengths were also taken in the laboratory, as soon as the specimen was weighed. Lengths were recorded in millimeters, using a standard fish measuring board, obtained from Wildco of Michigan.

Data was entered into the Burroughs 5700 computer located at John Carroll University where the calculations were made. The standard foumula for the calculation of K was utilized. The formula is given below:

$$K = W(10^5) / L^3$$

where W = Weight in grams
L = Length in millimeters, and the standard length is used.

Age

The age of certain species was determined by standard techniques of the reading of scale annuli. Specimens of scales were taken from fishes to be aged and stored in envelopes upon which the pertinent data was recorded. Scale impressions were made of several scales from each sample by the techniques described by Smith (140). Annuli were read using a Fish scale projector and magnification equipment (Eberbach, Inc).

Species Diversity Index

The species diversity index(calculated)was based on either gill net or seining samples. The two techniques were not compatable relative to catch per unit of effort and therefore, samples were treated as distinct data.

Gill net samples were all converted to a catch of 24 hours duration and with 1000 feet of experimental net. Often this necessitated the multiplication of a collection, but more often, samples were taken with nets of 1400 feet. The data was relatively uniform throughout the collecting period as pertains to the size of meshes and length of the net.

Seining samples were converted to a standard of one hour of effort. Since the crews utilized only one seine at a time this resulted in a rather uniform conversion of data.

The species diversity index calculated is that of Shannon-Weaver. The formula utilized is presented below, and is compatable with that used by the other investigators involved in the Phase one project.

$$\overline{D} = -\sum(n_i/n) \log_2 (n_i/n)$$

where n_i = the number of individuals in the i species
n = the total number of individuals in all species

In addition, the maximum diversity was calculated, in order to provide an assessment of species richness. This was calculated according to the formula:

$$\overline{d}_{max} = \log_2 S$$

where S = the number of species present.

Equitability was calculated between the diversity and maximum diversity and is presented as the value of E. this was calculated according to the formula:

$$E = \overline{D} / \log_2 S$$

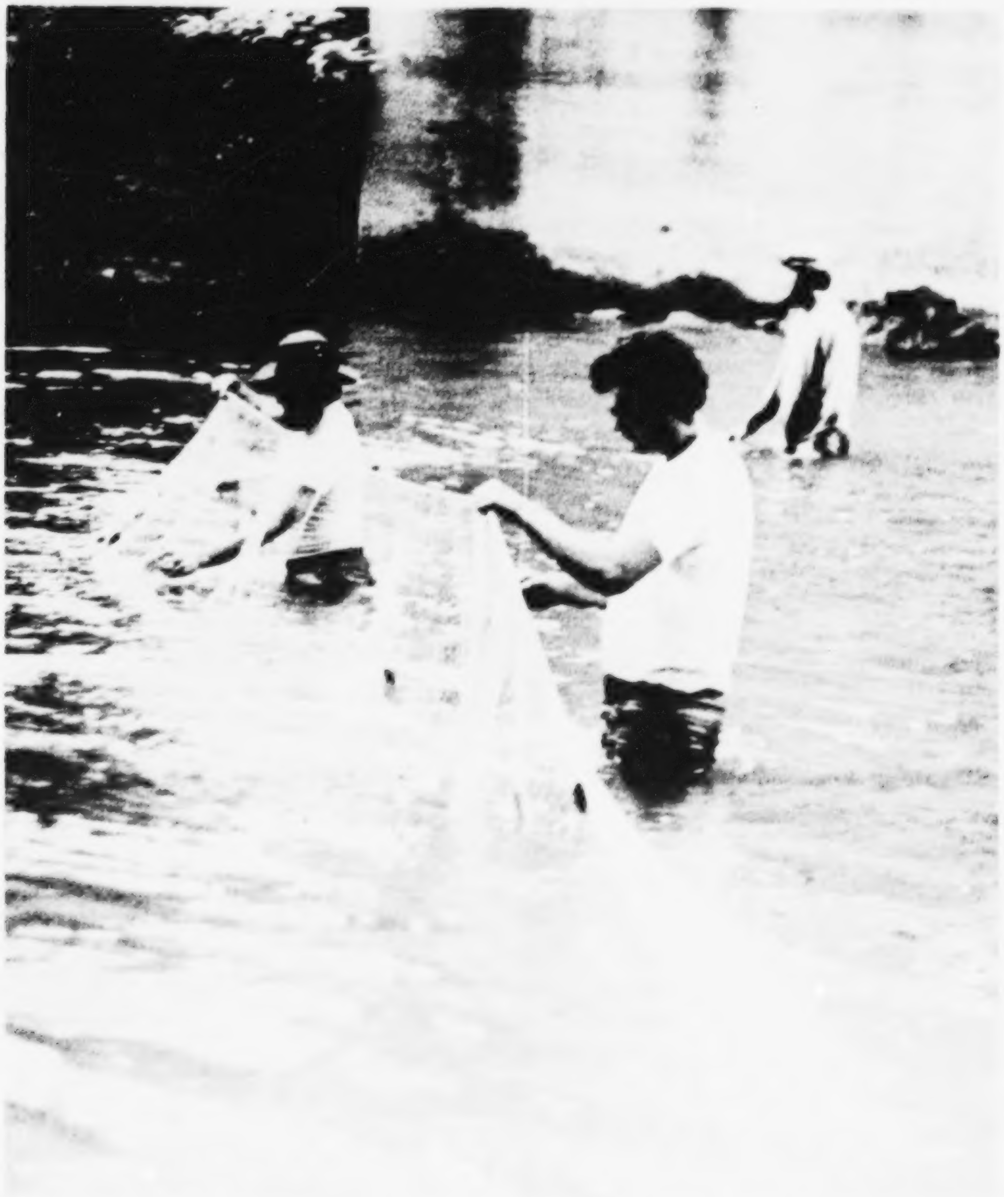

Figure 8: Gill Netting in Streams.
Gill net collections were made in areas of streams where seining or fyke net collections were impractical due to depth or substrate.

SECTION VI

STUDY RESULTS AND DISCUSSION

Utilizing all of the methods described, more than 77,000 specimens of fishes were captured and examined. All except approximately 7,000 of these were subsequently released. These latter specimens are currently preserved in the museums of the John Carroll University, University Heights, Ohio or The Ohio State University Museum of Zoology, Columbus, Ohio. They will be maintained by these museums for future documentation and/or research.

The results of this study were primarily intended to provide a firm baseline of both past and present distribution and abundance of fishes in the Cleveland Metropolitan area. A total of 107 species and subspecies are included in the following discussion, representing 60 per cent of all species of fishes known to have occurred in the state of Ohio.

Individual Species Accounts, Past and Present

In discussing these 107 species and subspecies, we recognize that fish populations fluctuate, sometimes radically, from year to year. Realizing this we feel that a few years data are insufficient to discuss abundance except in relative terms. Therefore, the terminology such as "abundant" or "common" are necessarily vague, and are intended only to provide gross quantitative measures. For those who wish to examine the actual numbers of each species collected, these figures are presented in tabular form at the end of the discussion. In general, our definition of the terms utilized in the discussion is as follows:

(1) Extremely Abundant

present in huge concentrations; utilizing the proper technique, they are normally extremely easy to collect and comprise a major percentage of most collections.

(2) Abundant

present in fairly large concentrations; occurring in most collections, sometimes in considerable numbers.

(3) Common

sufficiently numerous to be present, at least in some numbers, in almost every collection.

(4) Uncommon

usually present in small numbers, at least a few individuals occurring in some collections.

(5) Rare or Commercially Extirpated

either present in only a very few collections and then represented by only one or a few individuals; or when the numbers captured commercially are so few as to be economically unprofitable.

(6) Scientifically Extirpated

a species is considered to be scientifically extirpated if it was not taken by any type of scientific or commercial collection technique, regardless of the effort to do so.

(7) Probably Extirpated

a species is considered to be probably extirpated when no specimens have been captured for several years despite a determined effort. It should be understood that in such a large body of water as Lake Erie, it is possible for a species to survive for years in a small, isolated area of favorable habitat. As such, it might be undetected by ichthyologists but increase again in the future if favorable conditions should once again become available. Therefore, it is difficult to state unequivocably that any species is extinct in Lake Erie.

Many species of fishes are highly migratory and may enter an area only occasionally, sometimes in an annual cycle. In order to indicate these conditions, the terminology described above is further qualified at times by the adjective Seasonally. Where applicable, such a designation is given immediately following the evaluation of abundance.

The adjective Locally is used to qualify a species which has a very specific habitat requirement. Such a species may be restricted in its range throughout the study area, but may be abundant in limited areas. This qualification immediately follows the evaluation of abundance.

The primary habitation (Lake, Stream, Ubiquitous) is also given for each species. This is essential to an adequate understanding of the distributions as presented in the following discussion. It should be noted however, that the preferred habitat for each species refers to the habitat of the species within the study area. In other parts of Ohio or elsewhere, the species may be found in different areas. In this discussion the following general definitions are utilized:

(1) Lake

Refers to the preference of the adult members of a species for lentic or lower river waters.

(2) Stream

Refers to the preference of the adult members of a species for lotic waters.

(3) Ubiquitous

Used when the adult members of a species occur in both lentic and lotic habitats as residents (not as strays only).

In reading the following discussion it should be remembered that the data contained in Volume I of this report was printed prior to the completion of Volume II. The authors of Volume I were unaware of the data that was to be collected in the summer of 1974. Therefore, the numbers of specimens, and the total number of species in areas such as the Cleveland Harbor are increased in Volume II. This is due to additional data, and not to error on the part of the authors of Volume I.

INDIVIDUAL SPECIES ACCOUNTS OF THE STUDY AREA FISH FAUNA

1. SILVER LAMPREY, Ichthyomyzon unicuspis [1]

RARE [2] LAKE [3]

Before the breeding streams were dammed and polluted immense numbers of this parasitic lake species of lamprey ascended streams for the purpose of spawning.

A decrease in abundance was observable by 1900 and this decline has continued until the present.

An individual was collected during June of this survey. This specimen was taken in the Chagrin River, presumably ascending in an attempt to spawn. Additional specimens were collected in areas adjacent to the study area by Lake Erie commercial fishermen. In discussions with these fishermen we were informed that the species is rarely observed, and that during most years they collected fewer than twenty-five individuals. This species and the Sea Lamprey are often confused; therefore, the total observations of these fishermen most probably represent a composite of both species.

(References; 66, 101, 119, 147, 150) [4]

2. SEA LAMPREY, Petromyzon marinus

RARE LAKE

Apparently this parasitic species invaded Lake Erie after 1930 (147) but according to available records it has never become abundant. Its confusion with the Silver Lamprey has led to the belief that it was more common than is actually the case. Preserved specimens indicate that it has always been rare in Lake Erie.

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[1] Scientific and common names from Bailey, et. al., 1970: for subspecific status see Trautman, 1957.

[2] Relative abundance in the study area during this survey.

[3] Preferred habitation within the study area.

[4] These references are all of the available literature sources concerning the species in the Cleveland area of which we are aware. For historical information concerning the species in Ohio see reference number 147; for recent information concerning Lake Erie status see 150; all other references cited are specific. Reference numbers within the text are cited for the readers benefit and may be utilized for fuller and more comprehensive documentation of the specific subject or incident.

Two specimens were collected during this survey, both in the Chagrin River, apparently ascending the stream in an attempt to spawn. Two specimens were collected in Lake Erie, adjacent to the study area, near Avon Lake, Ohio. One was attached to a Carp, the other to a Freshwater Drum. The same factors of siltation, damming and pollution which have contributed to the decline of the Silver Lamprey have limited the success of the Sea Lamprey.

(References; 37, 147, 150)

3. AMERICAN BROOK LAMPREY, Lampetra lamottei

LOCALLY COMMON STREAM

This stream inhabiting, non-parasitic lamprey may be readily collected during its limited spawning season. At other times of the year, (as ammocoetes, the larval form) it may be obtained by digging in the stream bottoms. No attempt was made to collect this species, although a single adult was seined in the Chagrin River during 1972. The species is recorded from numerous localities in the upper portions of the Chagrin River drainage (147) and in these areas it probably occurs commonly.

(References; 147, 150)

4. LAKE STURGEON, Acipenser fulvescens

SCIENTIFICALLY EXTIRPATED LAKE

This large species, sometimes attaining a weight of 200 pounds, was an important food source before 1900. It spawned in large numbers in streams such as the Cuyahoga River prior to 1830. According to Kirtland (95), spawning runs had ceased in the Cuyahoga on or before 1850 and the numbers of individuals in the open lake had drastically declined. This decrease in numerical abundance is obviously the result of stream obstructions which prevented sturgeons from reaching the upstream spawning grounds. The deterioration of the Cleveland shoreline accounts for its early avoidance of the areas near the shore.

After 1900, sturgeon populations which remained continued to decline. In the early 1900's only a few specimens were taken per year by commercial fishermen and by 1930 the species was considered extremely rare, only occasional specimens being observed per year.

No documented specimens have been recorded in the Cleveland area for several years. A concerted effort to collect one was made during this study but none was taken. The species is currently a member of the

Ohio Endangered Species List.

(References; 70, 74, 95, 119, 147, 150)

5. SPOTTED GAR, Lepisosteus oculatus

PROBABLY EXTIRPATED LAKE

Kirtland (95) stated that "a specimen was taken near Cleveland..." about 1850 or 1851.

None has been collected in the Cleveland area since. This species is also considered to be an Ohio Endangered Species.

(References; 96, 119, 147, 150)

6. LONGNOSE GAR, Lepisosteus osseus

UNCOMMON LAKE AND LOWER RIVERS

This gar was formerly numerous in areas where aquatic vegetation was abundant. Lesser populations were present in other areas along the shoreline and middle sections of the river drainages wherever deep pools were present.

After 1900, disappearance of the aquatic vegetation and increased siltation resulted in the drastic decline of this species.

At present, small populations occur in and near the mouths of the Rocky and Chagrin rivers, especially where the water is quiet and vegetated. The majority of the specimens of Longnose Gar were taken in the marina channels of the Chagrin. This gar occasionally enters the open lake and individuals were recorded in some Lake Erie shoreline marinas. Two specimens were collected within the Cleveland Harbor.

(References; 68, 97, 115, 119, 147, 150)

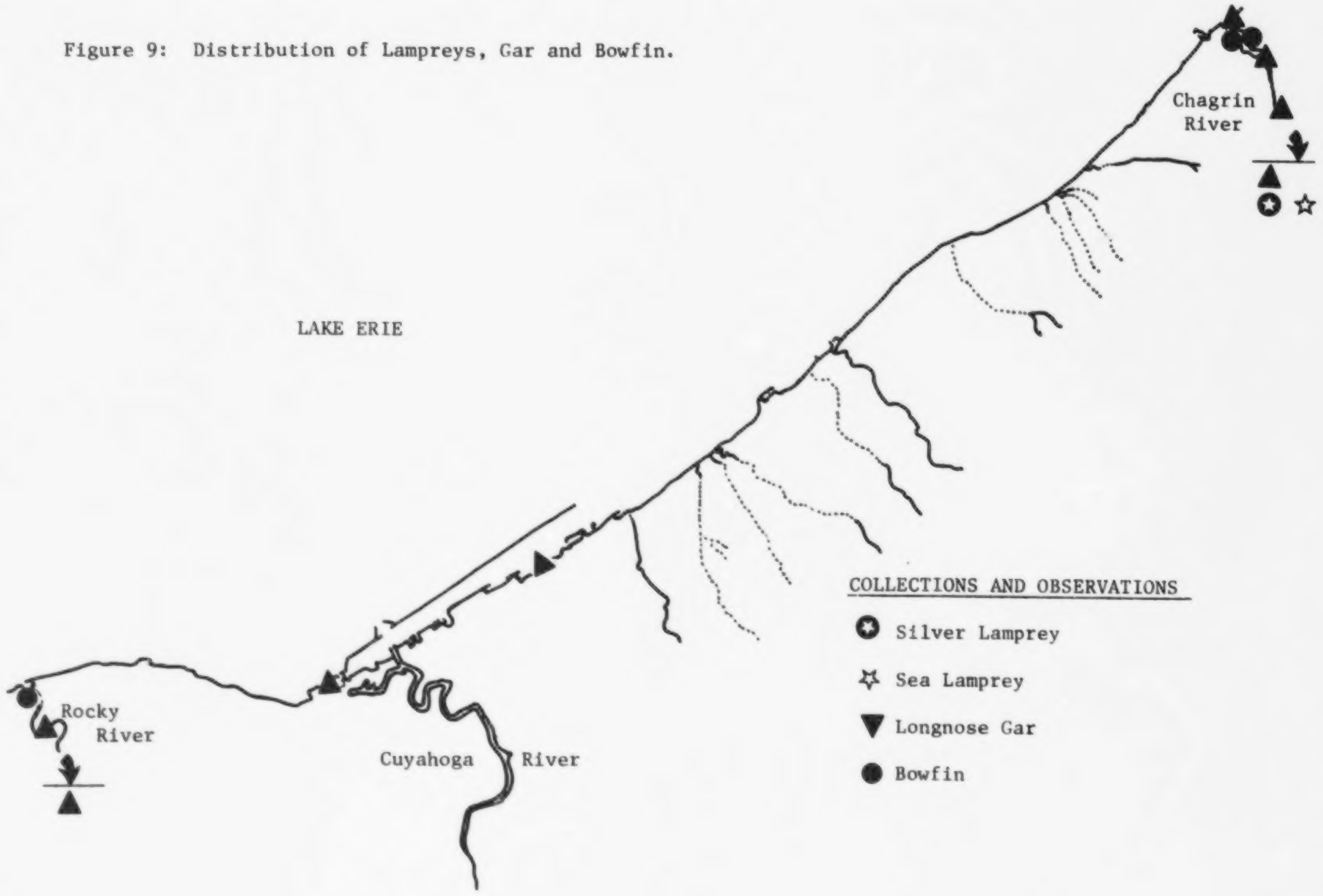
7. BOWFIN, Amia calva

UNCOMMON LAKE AND LOWER RIVERS

Originally the Bowfin was present in areas of low gradient streams and embayments which were heavily vegetated. Kirtland reported that the species was abundant in Lake Erie prior to 1851 (98). Since then it has declined in abundance greatly.

During this survey two specimens were collected in the lower Chagrin River. A few individuals were reported by anglers who caught them in the lower Rocky River. Its present scarcity is probably the result

Figure 9: Distribution of Lampreys, Gar and Bowfin.



of the decrease in aquatic vegetation and the filling of the shoreline marshes.

(References; 64, 67, 98, 115, 119, 147, 150)

8. AMERICAN EEL, Anguilla rostrata

PROBABLY EXTIRPATED LAKE

Kirtland (69) heard rumors of eels in Lake Erie waters after the completion of the Welland Canal in 1829. It was not until sometime later (date unrecorded) that he examined an eel caught in the Cuyahoga River in Cleveland (147). This may have been the same one that Garlick mentioned, that was taken "...last year (1856)..." in the Cuyahoga River (35). In 1882. the Ohio Fish Commission began planting elvers in Ohio waters and by 1887 they mentioned the capture of eels throughout Ohio, especially in the Lake Erie drainages.

The species was fairly numerous following their introduction but we have few records and little information realtive to eels after 1900.

Recently, no records of eels in the study area have been cited in the literature and none was taken during the survey. It is assumed that the stockings of eels did not produce a self-sustaining population in this area.

(References; 35, 69, 119, 147, 150)

9. ALEWIFE, Alosa pseudoharengus

COMMON LAKE

This herring was first reported from Lake Erie in 1931, having probably invaded through the Welland Canal. The species has not become as numerous in Lake Erie as it has in others of the Great Lakes.

It continues to be uncommon as an adult in the immediate Cleveland area but during the survey large numbers of fry were collected in the shallow areas along the shoreline. Adults were most frequently encountered during the colder months of the year and the largest numbers of fry were taken near the mouth of the Chagrin River.

(References; 32, 147, 150)

10. EASTERN GIZZARD SHAD, Dorosoma cepedianum

EXTREMELY ABUNDANT UBIQUITOUS

Kirtland (75) considered this species as a recent invader (circa 1851) into Lake Erie from the Ohio River drainage via the recently constructed canals. However, it is now generally believed by ichthyologists to have been present in Lake Erie throughout historic times. It is generally assumed that then the population was low and largely unconcentrated, and was therefore, unnoticed.

With the advent of power plants producing thermal discharges, shad have become increasingly observable because of their tendency to concentrate at such outflows during the winter. Their inability to survive rapid temperature changes has resulted in massive kills. The presumed increase in plankton, their principal source of food, has probably resulted in a great increase in numbers.

At present this species is extremely abundant in the Cleveland area, congregating in immense numbers at warm water discharges and near the mouth of the Cuyahoga River during winter. In summer, it retires to the deeper portions of the lake and is frequently absent from the Cleveland Shoreline. During the survey, this species was represented in approximately half of the collections from Lake Erie and the lower portions of the three river drainages.

(References; 64, 75, 119, 147, 150, 163)

11. MOONEYE, Hiodon tergisus

SCIENTIFICALLY EXTIRPATED

LAKE

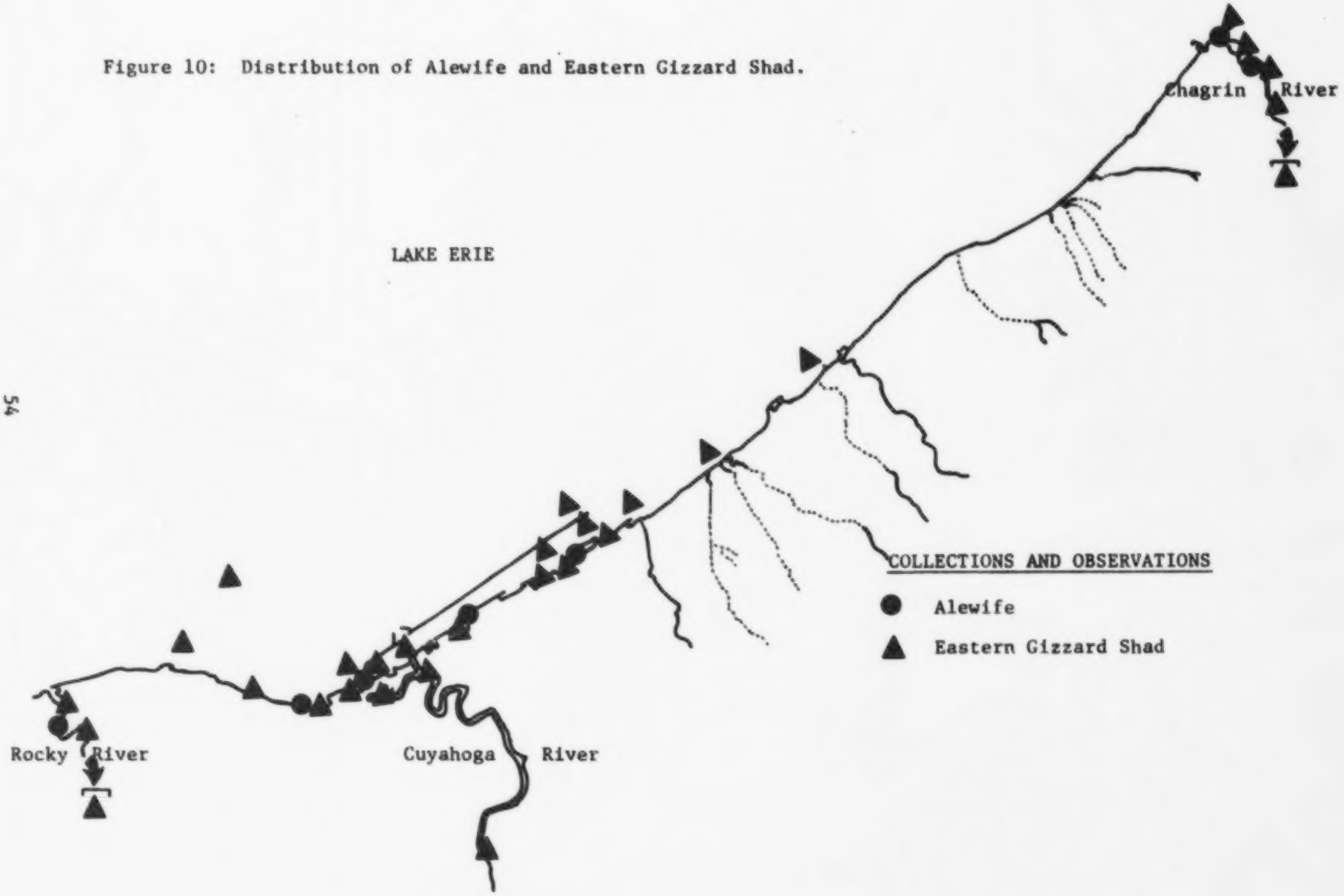
Kirtland stated in 1847 (73), and again in 1851 (103), that "...this fish abounds both in Lake Erie and the Ohio River. It was not very highly valued for food." Commercially, it was then and is now considered among the "trash" species and no accurate commercial records of its abundance exist.

Apparently, the species remained abundant until after 1935, after which it decreased sharply. During the depression of the early 1930's many Cleveland area residents utilized these as a food source, spearing them in great numbers near hot water outflows.

Although a careful search was made for this species during this survey, both in Cleveland and adjacent areas, not a single specimen was collected. Apparently, the increase in siltation, turbidity and the decline in suitable prey have contributed to the sudden disappearance of this species.

(References; 55, 73, 103, 119, 147, 150)

Figure 10: Distribution of Alewife and Eastern Gizzard Shad.



12. CHINOOK SALMON, Oncorhynchus tshawytscha

SEASONALLY COMMON LAKE

This species was first introduced unsuccessfully into Lake Erie waters in 1875.

After 1890, it was occasionally reintroduced into the lake waters (150). The first successful introductions occurred in the 1970's when large numbers were introduced into the East Branch of the Chagrin River.

Commercial fishermen reported fair catches of salmons during the survey from areas adjacent to Cleveland, presumably of both Chinook and Coho. Fourteen adult Chinook were collected during this survey from five localities, including Cleveland Harbor, and recently, sport fishermen at Gorden Park (near station five) caught many salmon which we assume to be chinooks. Collections indicate that the stocked fingerlings remain in the Chagrin River until the March following their release. Downstream migration occurs after this and by May none was collected in the streams. It is doubtful that any reproduction is occurring in the study area.

(References; 9, 55, 150)

13. COHO SALMON, Oncorhynchus kisutch

SEASONALLY COMMON LAKE

As with the Chinook, this species was stocked irregularly without success between 1876 and 1930 (150).

It was first successfully introduced into Lake Erie by planting thousands of fingerlings in the Chagrin River during the years 1968 to 1970.

In 1972 this species was captured in Lake Erie by commercial fishermen, sometimes in fair numbers. Specimens also were taken in the Chagrin River, Rocky River, Cleveland Harbor and Edgewater Park. Apparently, the species does not spawn in the Cleveland area, and the maintenance of the Lake Erie population is entirely the result of restocking.

(References; 9, 55, 136, 150)

14. BROWN TROUT, Salmo trutta

RARE STREAM

This species is not native to North America.

Brown trout have been sporadically stocked in Ohio tributaries since 1934 and possibly before, with little success (147).

During the survey, approximately 50 adults escaped into the Chagrin River drainage from a trout club in Geauga County. Occasional specimens are captured by sportsmen fishing in the Chagrin; and it is assumed that such specimens are the results of similar escapes from stocked ponds. One specimen was collected in the East Branch, Chagrin River.

(References; 147, 150)

15. RAINBOW TROUT, Salmo gairdneri

UNCOMMON STREAM

This trout was apparently introduced about 1886 with little success (147). Its original range was western North America.

The species was successfully introduced recently in the Chagrin River where thousands of fingerlings were released. In this river, collections of many recently stocked fingerlings were made and in addition, several yearlings were collected. Successful reproduction has occurred in at least one of the tributaries of the East Branch, Chagrin River. Both adults and very small young were collected at one site.

Adults of this species are occasionally taken by sportsmen in the lower Chagrin River and in 1974 we collected two specimens of Rainbow Trout in the Cleveland Harbor. As with the Brown Trout, numerous escapes of large adults occur from the trout clubs in the upper portions of the Chagrin River.

(References; 9, 121, 147, 150)

16. BROOK TROUT, Salvelinus fontinalis

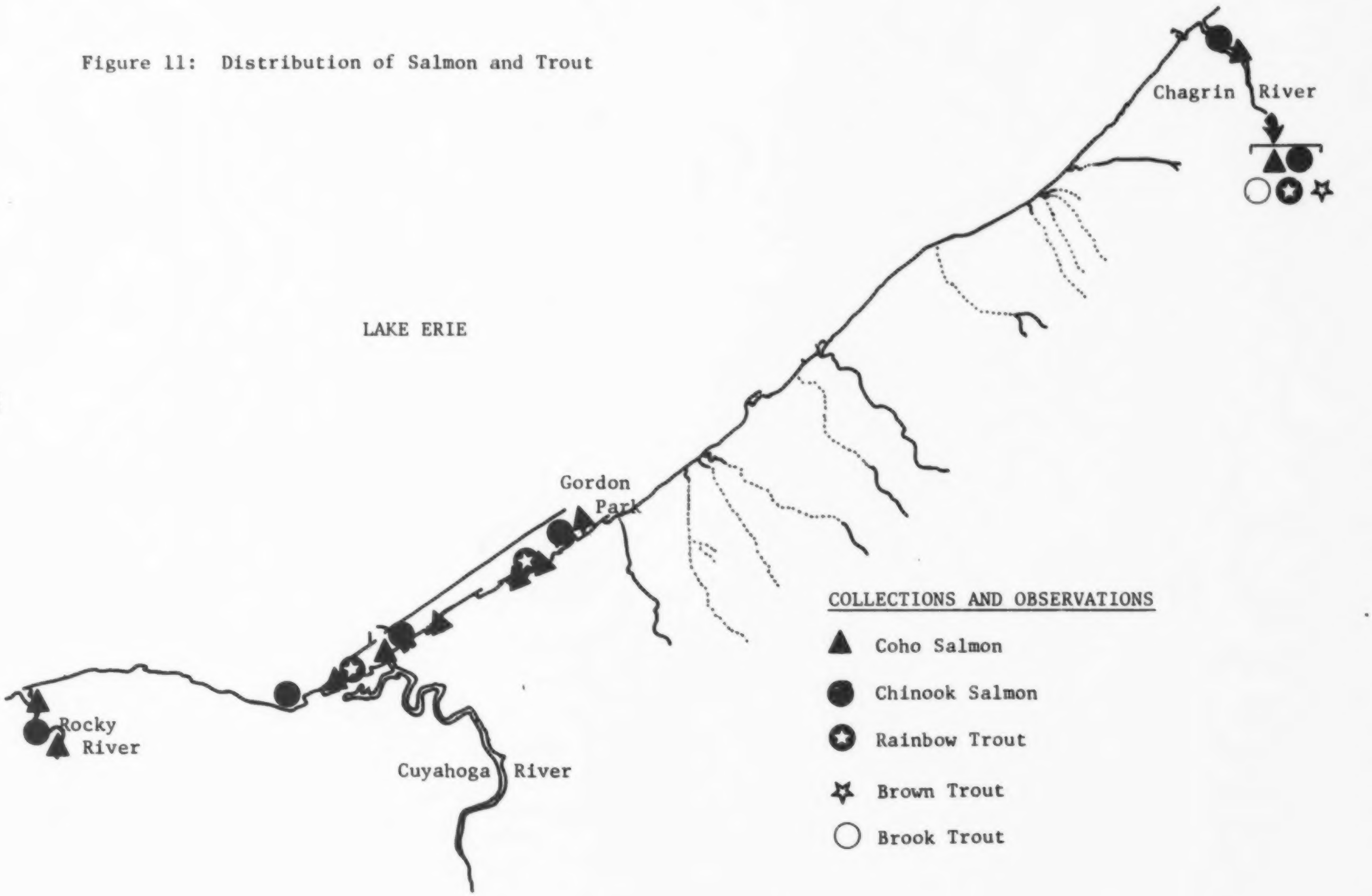
RARE STREAM

Kirtland stated that originally "speckled trout" occurred in "...a branch of the Chagrin River, in Geauga County."

The species was sporadically introduced, unsuccessfully, both intentionally and accidentally between 1900 and 1970.

No specimens were collected during the survey but in 1974 we observed a single specimen in a tributary of the East Branch, Chagrin River in Geauga County. As numerous escapes of this species are also reported from local trout clubs in the area, it is probable that the species exists in very small numbers in the East Branch. It is doubtful

Figure 11: Distribution of Salmon and Trout



that successful reproduction of this species occurs in the study area.

(References; 35, 64, 147, 150)

17. LAKE TROUT, Salvelinus namaycush

PROBABLY EXTIRPATED LAKE

This trout was formerly considered common (147). Kirtland (100), noted its capture before 1850 from Lake Erie near the mouths of the Cuyahoga and Rocky Rivers.

Apparently the species began to avoid the Cleveland shoreline as early as 1860, and simultaneously began to decline in Lake Erie. Its decline in Lake Erie was steady and by 1950 it had become nearly extirpated.

Although the decline of this species in other Great Lakes was attributed to the effects of the Sea Lamprey, it is doubtful that lampreys caused the Lake Erie decline. Rather we agree with the suggestion of Hartman and feel that low dissolved oxygen levels in the deeper portions of the lake are the significant contributing factor to its decline (37). No recent specimens have been reported and none was collected during the current survey.

(References; 37, 68, 100, 147, 150)

18. CISCO or LAKE HERRING, Coregonus artedii

COMMERCIALLY EXTIRPATED LAKE

According to Garlick (35), the species was immensely abundant along the Cleveland Shoreline prior to 1850.

In 1917 the commercial catch from Cuyahoga County was 3,536,647 pounds and had a value of $297,030.00 (40). A drastic decrease occurred after 1946 and by 1967 the total Ohio catch was reported to be 5 pounds (133). This species has not recovered from this decline and local commercial fishermen currently report only occasional specimens. No specimens were collected during the current survey. The reasons for its decline are speculative. The principal causes are believed to be the combined effects of the deterioration of its spawning habitat due to siltation and the overfishing during the spawning season.

(References; 35, 37, 40, 68, 147, 150)

19. LAKE WHITEFISH, *Coregonus clupeaformis*

COMMERCIALLY EXTIRPATED LAKE

The whitefish, a favorite food species, was formerly abundant in the Cleveland area especially during the spring and fall. More than a million pounds annually were brought into Ohio ports prior to 1900.

This species decreased in abundance during the next two decades but remained common. In 1917, 98,046 pounds were taken in Cuyahoga County.

This decline continued, and by 1963 the total catch for all Ohio ports was only 699 pounds (40). No specimens were collected during the current survey although occasional whitefishes were reported by local commercial fishermen, captured four to seven miles offshore. Commercial fishermen believe that this species avoids turbid waters. This may account for the fact that it is occasionally taken offshore but not near the shoreline in the Cleveland area.

(References; 37, 40, 64, 67, 147, 150)

20. RAINBOW SMELT, *Osmerus m. mordax*

SEASONALLY ABUNDANT LAKE

This recent invader was first recorded for Lake Erie in 1936 and rapidly increased (147).

Spawning success in Cleveland is limited because of the lack of suitable spawning grounds. The Cleveland population is probably supported by production from neighboring streams and adjacent beaches (147). It is abundant during early spring and late fall in all areas of the Cleveland Shoreline. The species is present in nearly half of our Lake Erie samples, and 846 individuals represent nearly 6% of the total fishes collected in Lake Erie. Adults occasionally ascend the lower portions of all three river drainages but do not contribute significantly to the total fish fauna of the streams. In late summer and early fall, young of the year are often very numerous in mouths of streams along the shoreline and in the Cleveland Harbor.

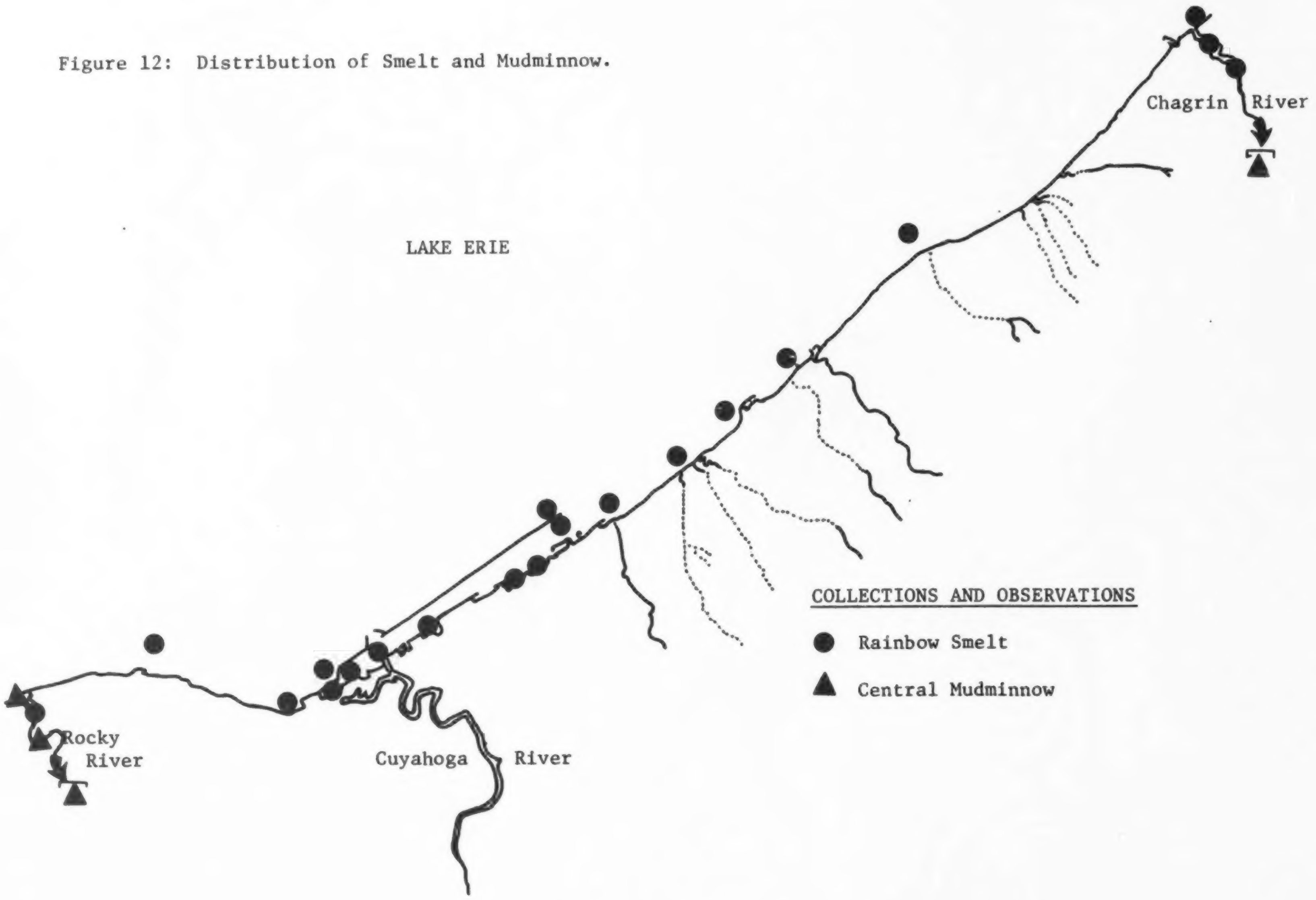
(References; 147, 150, 151)

21. CENTRAL MUDMINNOW, *Umbra limi*

LOCALLY COMMON STREAM

Although this species was undoubtedly present throughout historic times, no specimens were reported in the Cleveland area before 1890 (147).

Figure 12: Distribution of Smelt and Mudminnow.



A few specimens were recorded after 1900, these in isolated localities in the upper portions of the Cuyahoga and Chagrin River systems.

At present, the populations of Mudminnows are confined to only a few limited areas, presumably because of the lack of suitable habitat elsewhere. During the survey, Mudminnows were collected in the Chagrin and Rocky River drainages. Populations in the swampy portions of the Rocky River Reservation (Metropolitan Park) are large; those elsewhere are much smaller. The species is confined to marshy, heavily vegetated portions of the river systems, entering Lake Erie only as a stray. It is severely affected by draining and filling of swamps.

(References; 65, 119, 124, 147, 150, 163)

22. CENTRAL GRASS PICKEREL, *Esox americanus vermiculatus*

COMMON STREAM

Kirtland, in 1845 (107), (as *Esox umbrosus*) considered the species to be present in Lake Erie and some of its tributaries. Prior to this time, it was obviously present in such localities as the marshes of the lower Cuyahoga River, as described by Pease in 1797 (127).

It decreased in abundance after 1900 presumably because of extensive draining and filling of marshes.

During this survey, it was collected only in the Chagrin River drainage and the upper reaches of the Cuyahoga River. It is probably no longer present along the Lake Erie shoreline.

(References; 107, 119, 124, 127, 135, 136, 147, 150, 163)

23. NORTHERN PIKE, *Esox lucius*

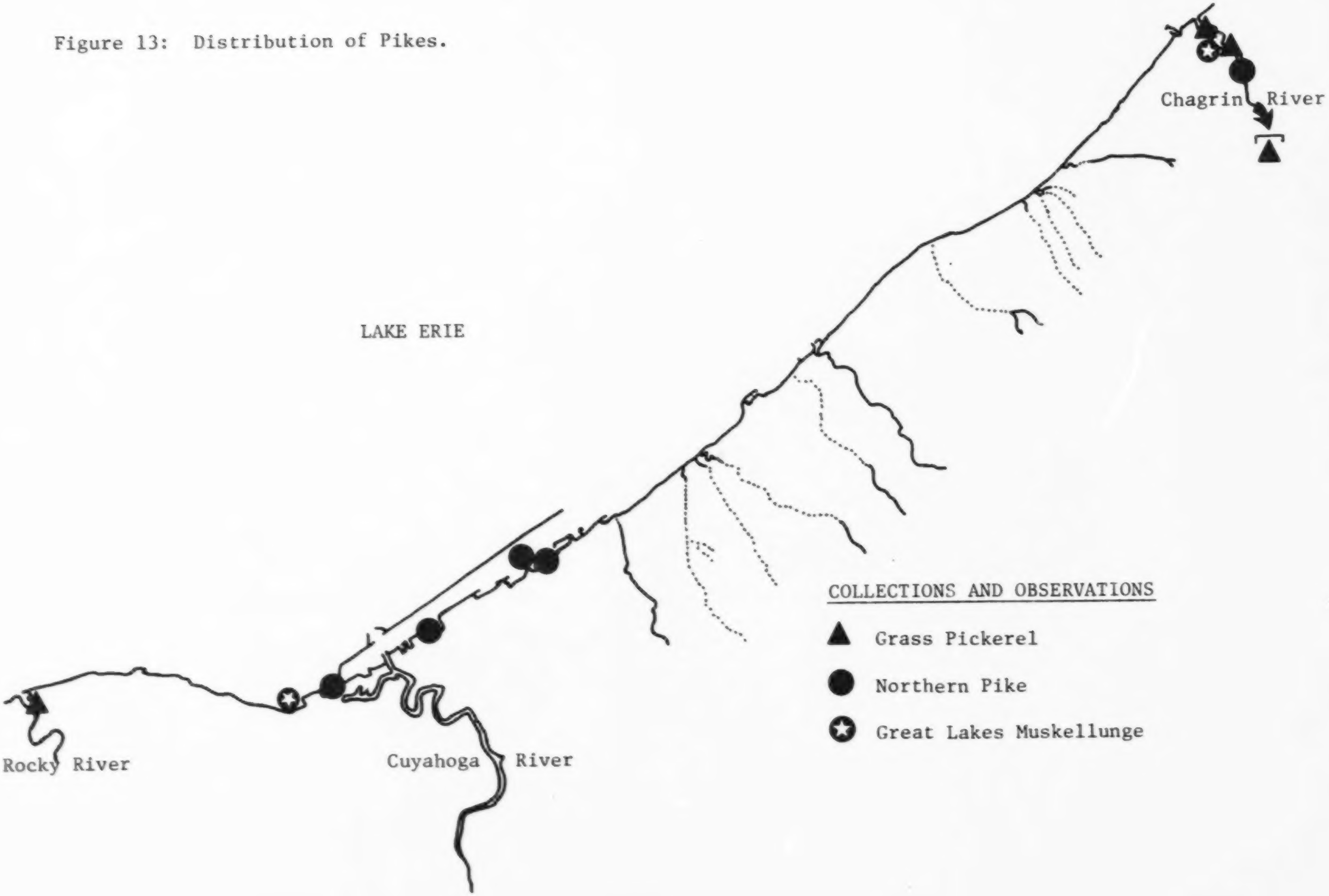
RARE LAKE

Little is known concerning the early abundance of the pike in this area because of the confusion existing between pike and muskellunge. Obviously it was numerous before the drainage of the extensive marshes along the shoreline and in the tributaries; and the damming of tributary streams.

Apparently, the pike remained relatively numerous after 1900. In 1922, 54,425 pounds were brought into Cuyahoga ports. However, the muskellunge was included in some of the above poundage as indicated by the lack of a reported poundage of muskellunge in 1922.

Presently, extremely small populations persist in and near the mouth of the Chagrin River, and in various marinas along the shoreline. Probably

Figure 13: Distribution of Pikes.



limited reproduction occurs in these areas since post-spawn females were collected in two marinas within the Cleveland Harbor. The populations of pike are present in the river and marinas during the entire year, and during 1973, more than 10 specimens were collected within the Cleveland Harbor. While this number may seem extremely low (and is) we include it here since only three Walleye were collected during the same period.

(References; 74, 69, 74, 91, 107, 111, 119, 144, 147, 150)

24. GREAT LAKES MUSKELLUNGE, Esox m. masquinongy

COMMERCIALLY EXTIRPATED LAKE

Klippart recorded this species as abundant in Lake Erie in 1830 (111). Kirtland in 1850 (74), stated that prior to that time "...muskellunge often run up the Cuyahoga several miles...". He also reported that "...forty years since (1811) this fish was far more abundant than at present (1850).", and that by 1850 "Muskellunge has become scarce, and no longer seeks the mouth of the rivers to deposit its spawn." The cause of this early decline was obviously the obstructions (dams) which prevented the reproduction of the species in upstream marshes.

Ditching, draining and removal of aquatic vegetation also caused a great decline in the abundance of this species after 1850.

According to the Ohio Division of Wildlife it occurs in very limited numbers near the mouth of the Chagrin River in spring. No specimens were collected by us during the survey, but a single specimen was taken by an angler in the Chagrin River in 1972. This was substantiated by a clear photograph which we have accepted. Also, one was collected in 1970 west of Cleveland Harbor by Mr. James Shaefer, of the City of Cleveland.

(References; 62, 72, 74, 90, 91, 111, 119, 144, 147, 150)

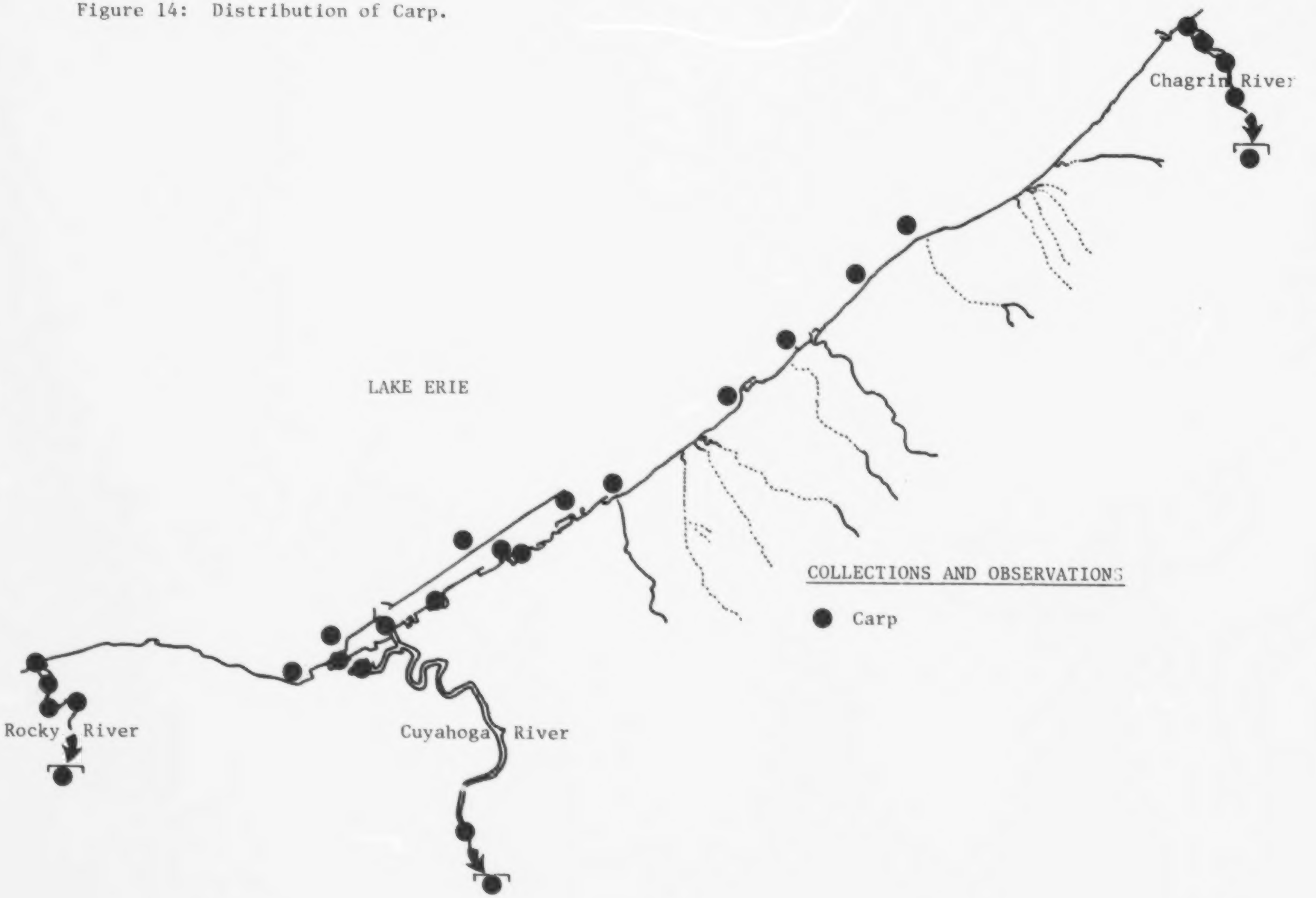
25. CARP, Cyprinus carpio

ABUNDANT UBIQUITOUS

In 1880, applicants in the Cleveland area received shipments of carp fry from the federal government for stocking purposes. These were primarily stocked in private ponds, where many escaped into nearby streams.

By 1900, probably due to the increased availability of suitable habitat resulting from enrichment of the water, it became firmly established

Figure 14: Distribution of Carp.



in Lake Erie and its Cleveland-area tributaries. In 1922, the Cuyahoga County catch was 47,021 pounds.

Presently, this species is well established and can be captured in any waters except those of highest gradients. It was present in over a fourth of the total collections made in the survey. It is most readily captured when large numbers of individuals are congregated in the lower portions of the rivers, when spawning in spring. This species hybridizes with the Goldfish.

(References; 115, 119, 124, 136, 137, 144, 147, 150, 163)

26. GOLDFISH, *Carassius auratus*

ABUNDANT LAKE

In 1850, Kirtland suggested that "if a little pains would be taken to introduce it into streams and ponds in this vicinity (Cleveland), it would soon become as numerous as our common minnows." (76). In 1885-86, some Ohio applicants received Goldfish from the federal government for stocking (147). The stockings were successful, and the species has increased in numbers.

After 1900, it continued to increase in abundance.

At present the Goldfish is very abundant in the lower rivers, harbors and shoreline marinas. It has been observed depositing eggs on the Cleveland Harbor breakwall, on pilings in nearby marinas and in the arm of the lower Cuyahoga River. Fry were collected in many locations including the lower Cuyahoga. The species interbreeds with the Carp.

(References; 76, 115, 120, 135, 136, 147, 150, 163)

27. GOLDEN SHINER, *Notemigonus crysoleucas*

LOCALLY COMMON UBIQUITOUS

Kirtland (70) considered the Golden Shiner as occurring in most of the ponds and lakes of Ohio and believed it to be a "valuable kind of bait for pickerel." It was abundant in the weedy, sheltered bays and vegetated marshes adjacent to Lake Erie, and in the vegetated sections of many of its tributaries (150).

This species gradually decreased in abundance after 1900 as the swamps and marshes were drained and aquatic vegetation decreased in amount.

At present, the Golden Shiner is restricted to isolated populations in heavily vegetated portions of headwater streams, existing in limited

Figure 15: Distribution of Goldfish.

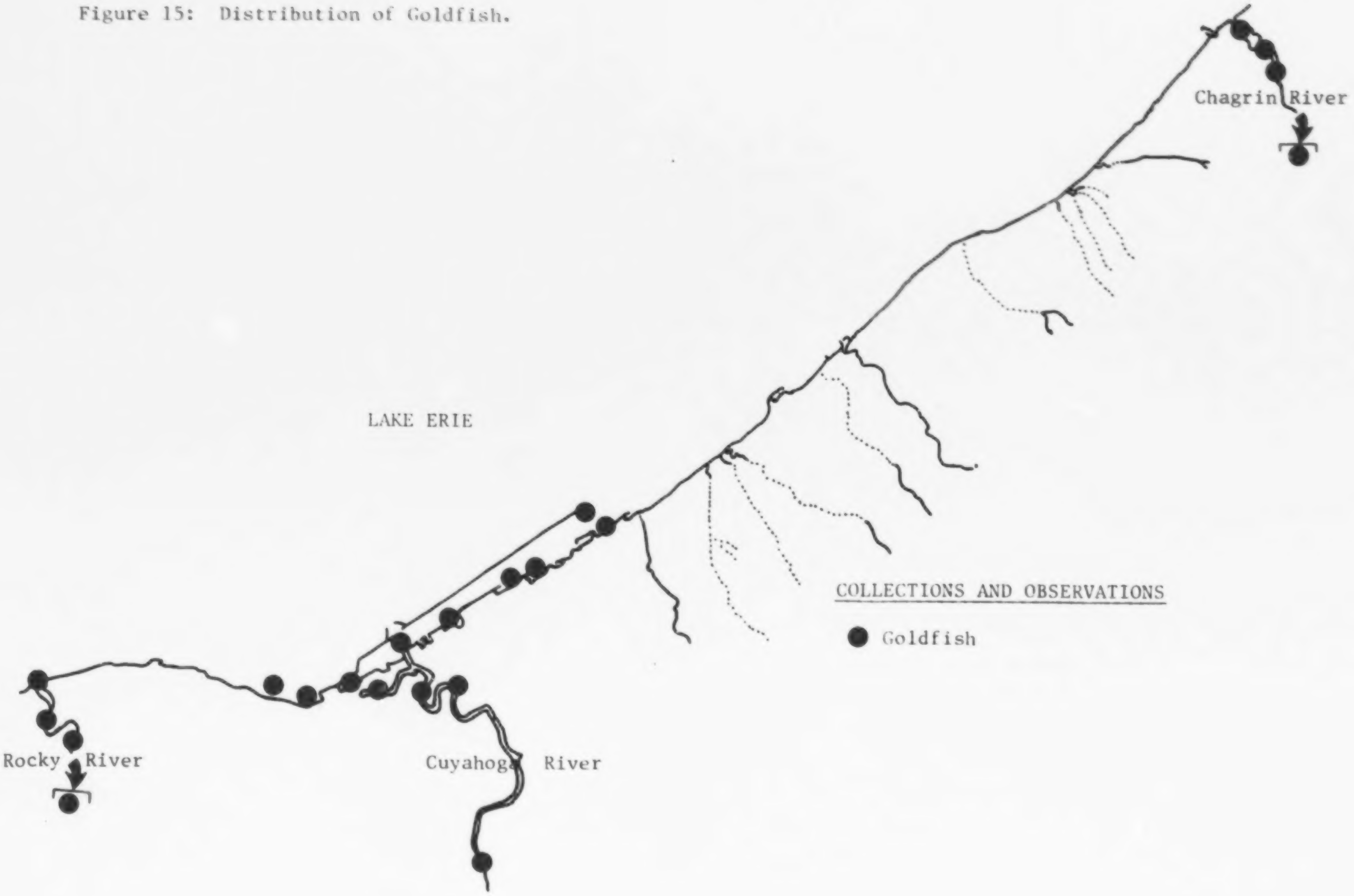
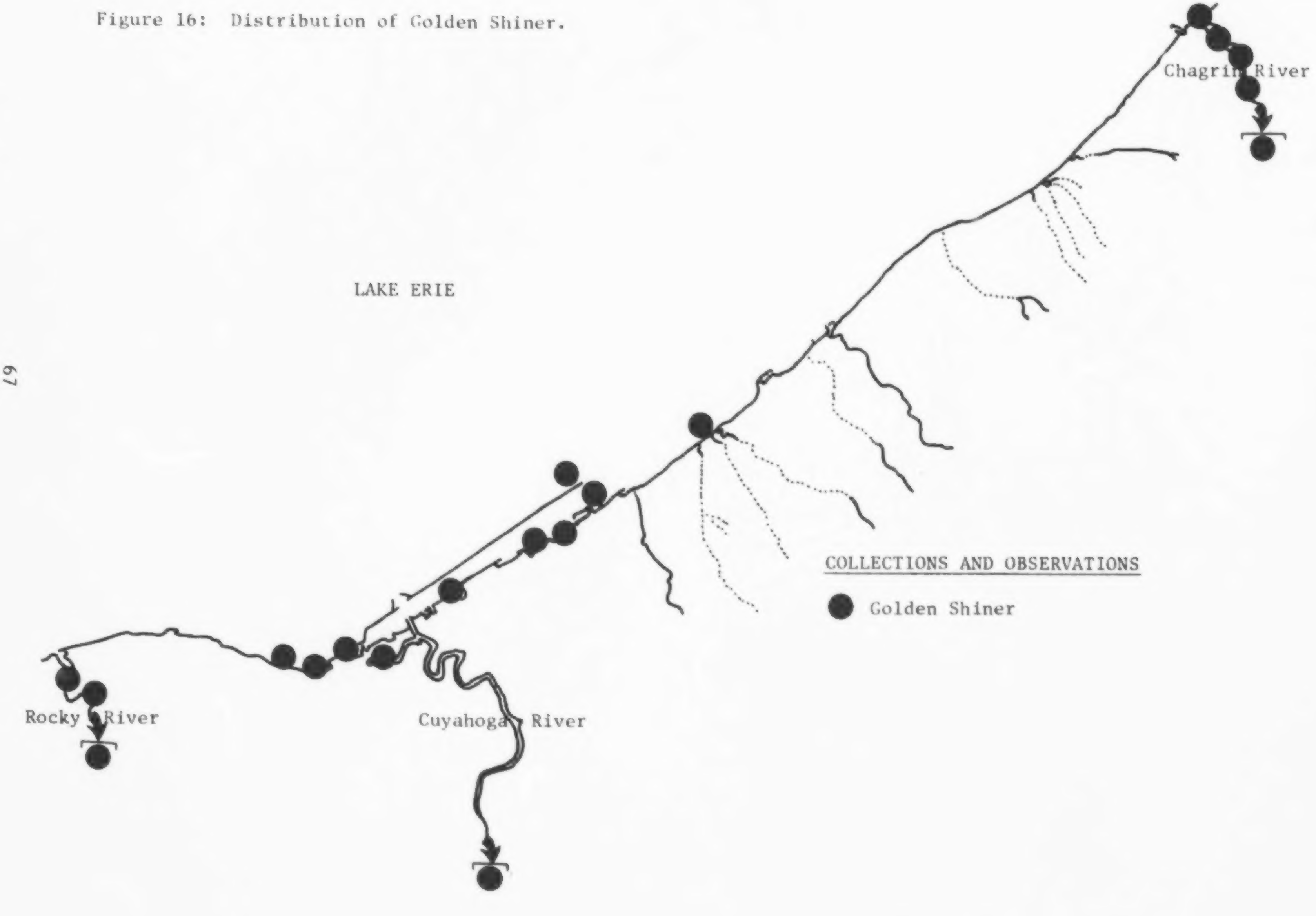


Figure 16: Distribution of Golden Shiner.



populations elsewhere including the lower portions of the tributaries, and along the shores of Lake Erie. It is numerous only in the shoreline marinas. Especially high populations occur in the Cleveland Harbor marinas, where the Golden Shiner is one of the most abundant forage species.

(References; 70, 119, 124, 147, 150, 163)

28. HORNYHEAD CHUB, Nocomis biguttatus

RARE STREAM

Because of the early confusion between this species and the River Chub, little is known of its early abundance. Preserved specimens are extant that were collected before 1901 (147).

After 1900, it declined greatly in abundance as its preferred habitat was destroyed by increased siltation in the medium gradient portions of streams which formerly provided a clean substrate and rooted aquatics.

During this survey, the Hornyhead was recorded from the upper reaches of the Cuyahoga River, where among profuse aquatic vegetation 15 specimens were taken in a short period. The species is limited to streams and was never reported from Lake Erie.

(References; 66, 119, 147, 150, 163)

29. RIVER CHUB, Nocomis micropogon

UNCOMMON STREAM

Little is known of the abundance of Hornyhead and River Chubs before 1900 because of the inability to satisfactorily distinguish the two species (147). However, early collections of specimens from the Rocky and Chagrin Rivers indicate that the River Chub may have been the most numerous of the two.

After 1900, there appears to have been a definite decrease in abundance, as occurred throughout the remainder of Ohio. As evidenced by museum specimens, it remained present in all three tributaries, probably declining with the increase in siltation.

During this survey, it was collected frequently in the clear waters throughout the Chagrin River system. One specimen was taken in the Rocky River and none in the lower Cuyahoga.

(References; 119, 147, 150)

30. SILVER CHUB, Hybopsis storeriana

SCIENTIFICALLY EXTIRPATED LAKE

Kirtland, in describing this species, gave its type locality as Lake Erie, (presumably in the vicinity of Cleveland), where it was taken from the deeper waters of the lake. Some were taken in shore seines as well. After midsummer, the young occasionally congregated in considerable numbers about the mouths of rivers and bays.

Lake Erie populations remained high until after 1955. Recently, there has been a drastic decline in this species in all of Lake Erie (150).

Intensive trawling in the deeper portions of the Cleveland shoreline, the river mouths and the harbors produced no specimens. It is assumed that this once abundant species is now near extirpation in the vicinity of Cleveland.

(References; 71, 85, 119, 147, 150)

31. BIGEYE CHUB, Hybopsis a. amblops

UNCOMMON STREAM

Kirtland did not recognize this species and there are few preserved specimens before 1900. However, there is no reason to doubt that it was at least as numerous in this area as in adjacent sections of Ohio.

Since 1900, the species has continued to decrease in abundance throughout Ohio and apparently in this area also.

Although intensive seining was done in the Chagrin and Rocky Rivers it was collected only in the middle portion of the Chagrin. This species may be present in limited numbers in the Rocky River and the upper portions of the Cuyahoga River. Its decline in numbers is apparently continuing.

(References; 119, 147, 150)

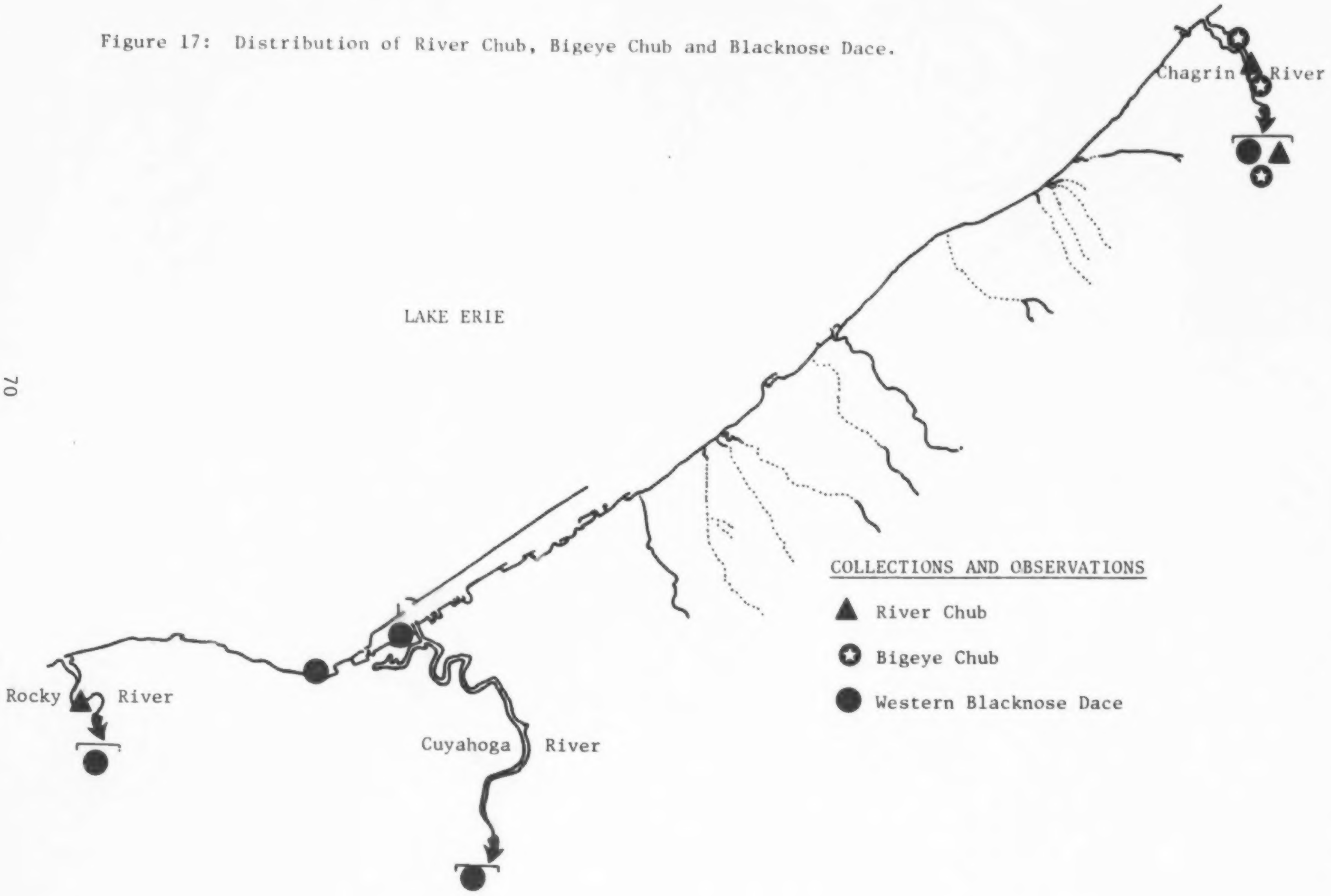
32. WESTERN BLACKNOSE DACE, Rhinichthys atratulus meleagris

LOCALLY ABUNDANT STREAM

It is believed by most ichthyologists that this dace was originally abundant only in the higher gradient streams east of the Allegheny Front Escarpment.

It was locally abundant after 1900 in smaller tributaries east of the Escarpment. Their numbers have recently decreased, as they did else-

Figure 17: Distribution of River Chub, Bigeye Chub and Blacknose Dace.



where in Ohio, because of intensive ditching and draining.

During the current survey, the species was locally abundant in such tributaries of the Chagrin River as the East Branch, Griswold Creek and Aurora Branch. Also, it was abundant in the tiny tributaries of the Cuyahoga River, such as Boston Run near Peninsula, Ohio.

(References; 119, 147, 150, 163)

33. LONGNOSE DACE, Rhinichthys cataractae

RARE UBIQUITOUS

There is no reason to doubt that the species was present on the shores of Lake Erie and in its tributaries, although no records are extant for the period before 1900.

It was recorded from the Grand River as early as 1900, but it was not until 1929 that the species was found to be fairly numerous in the Chagrin River drainage and along the Lake Erie shore during winter (147).

A small population apparently exists in Lake Erie that returns to the onshore areas and migrates up certain tributaries during the colder months. Intensive seining in suitable habitats along the Lake Erie shoreline and lower portions of the rivers produced only a few specimens. These individuals were collected on a riffle in the lower Rocky River and in isolated areas of the Cleveland Harbor. It is assumed that the Lake Erie population utilizing the Cleveland Metropolitan shoreline has been nearly extirpated. However, local populations exist in a limited section of the East Branch of the Chagrin River where they remain throughout the year. These populations appear to have been isolated by the establishment of the Willoughby Dam.

Throughout the year, another isolated population exists along a gravel bar at the mouth of the Chagrin where both adults and fry were frequently collected.

(References; 136, 147, 150)

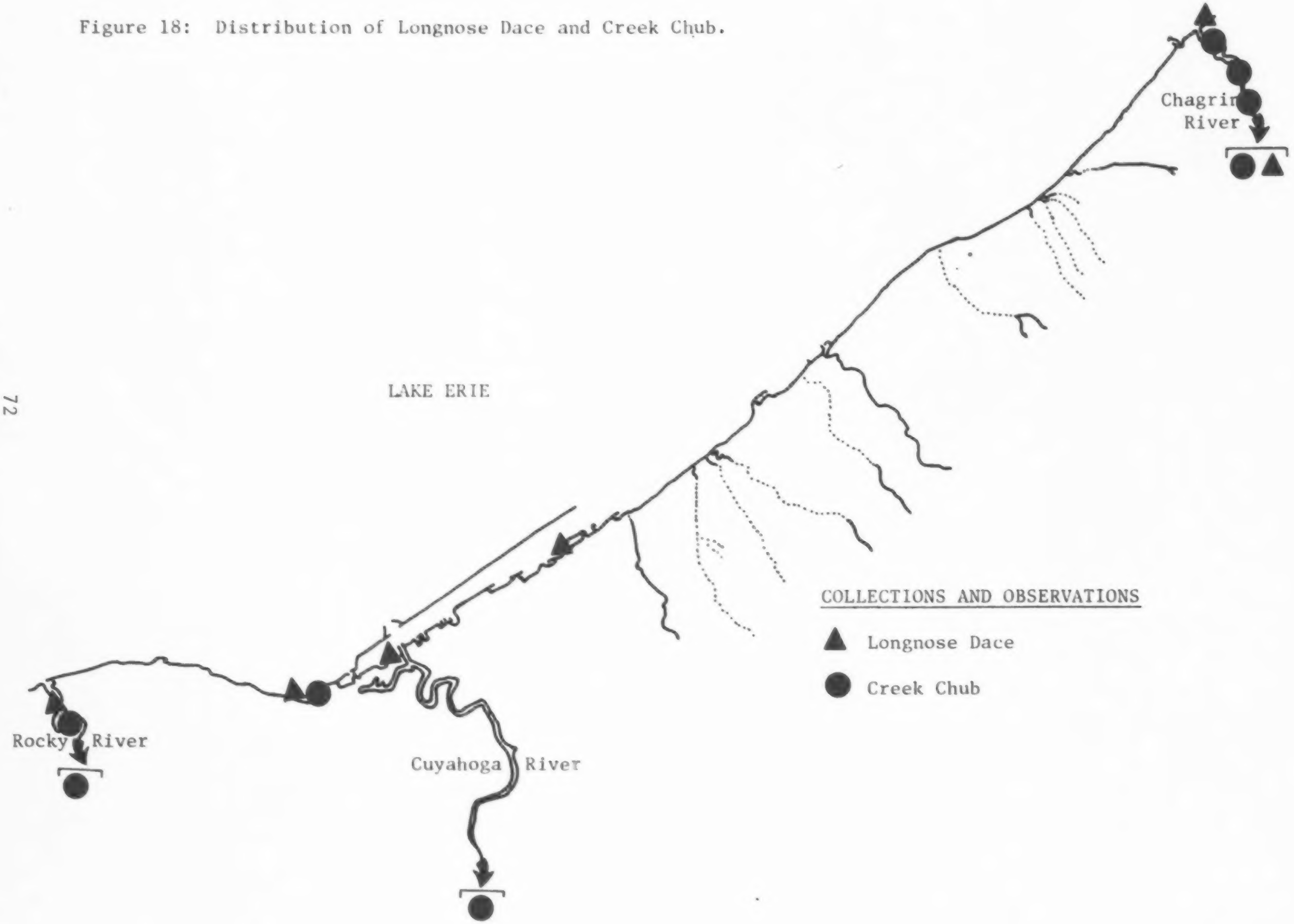
34. CREEK CHUB, Semotilus a. atromaculatus

ABUNDANT STREAM

In 1850, (77), Kirtland reported the species to be "abundant in every brook and river in Ohio." It was formerly caught by ice fishermen and considered to be an excellent panfish.

The many records in the local tributaries after 1900 indicate that it

Figure 18: Distribution of Longnose Dace and Creek Chub.



was still abundant.

This excellent forage and bait chub is presently abundant in all of the tributary streams of the study area, except the lower Cuyahoga River which is grossly polluted. None was taken in Lake Erie during the survey although it may occur there as an occasional stray.

(References; 77, 115, 119, 124, 136, 147, 150, 163)

35. SOUTHERN REDBELLY DACE, Phoxinus erythrogaster

LOCALLY COMMON STREAM

In 1844, Kirtland stated that during April and May, every stream swarmed with this species (68).

After 1900, the Redbelly was numerous only in the small tributaries of the three river systems in the study area where it was an associate of the Blacknose Dace. The species continued to decline in numbers and its populations in many areas were extirpated because of ditching, dredging and general deterioration of its habitat.

Currently it is taken in some very small, high gradient tributaries of the Chagrin River. It was also collected from similar habitats in the Rocky River drainage, and is probably present in similar tributaries of the upper Cuyahoga. This species does not normally inhabit Lake Erie or the lower portions of the rivers.

(References; 68, 77, 119, 147, 150, 163)

36. REDSIDE DACE, Clinostomus elongatus

LOCALLY COMMON STREAM

In 1841, Kirtland, in the initial description of the Redside Dace gave the Cuyahoga River as one of the type localities (66). Even though few specimens were saved, the species was probably widely distributed.

After 1900, it was recorded in the clear tributaries of the Cuyahoga and Chagrin Rivers east of the Allegheny Front Escarpment. Although preserved specimens are lacking, it probably was more widely distributed at this time than at present.

During this survey, the Redside Dace, as with the Redbelly Dace, was collected only in the tiny headwater tributaries. The species appears to be declining in numbers and is becoming more limited in distribution.

(References; 63, 66, 68, 119, 147, 150, 163)

37. PUGNOSE MINNOW, Notropis emiliae

RARE STREAM

As represented by specimens taken near the mouth of the Chagrin River, the Pugnose Minnow was present prior to 1900 (147).

Since then, no records of its presence have been documented anywhere in Northeastern Ohio, and it was considered by many to have been extirpated.

During the current study two specimens were collected, one each on June 6 and 16, 1972, in dense vegetation near the mouth of the Chagrin River. This relict population is currently endangered, and no other population is presently known in northeastern Ohio. Elsewhere in Ohio, only a few relict populations exist and the species is considered to be one of the state's endangered species.

(References; 62, 147, 150)

38. COMMON EMERALD SHINER, Notropis a. atheriniodes

ABUNDANT UBIQUITOUS

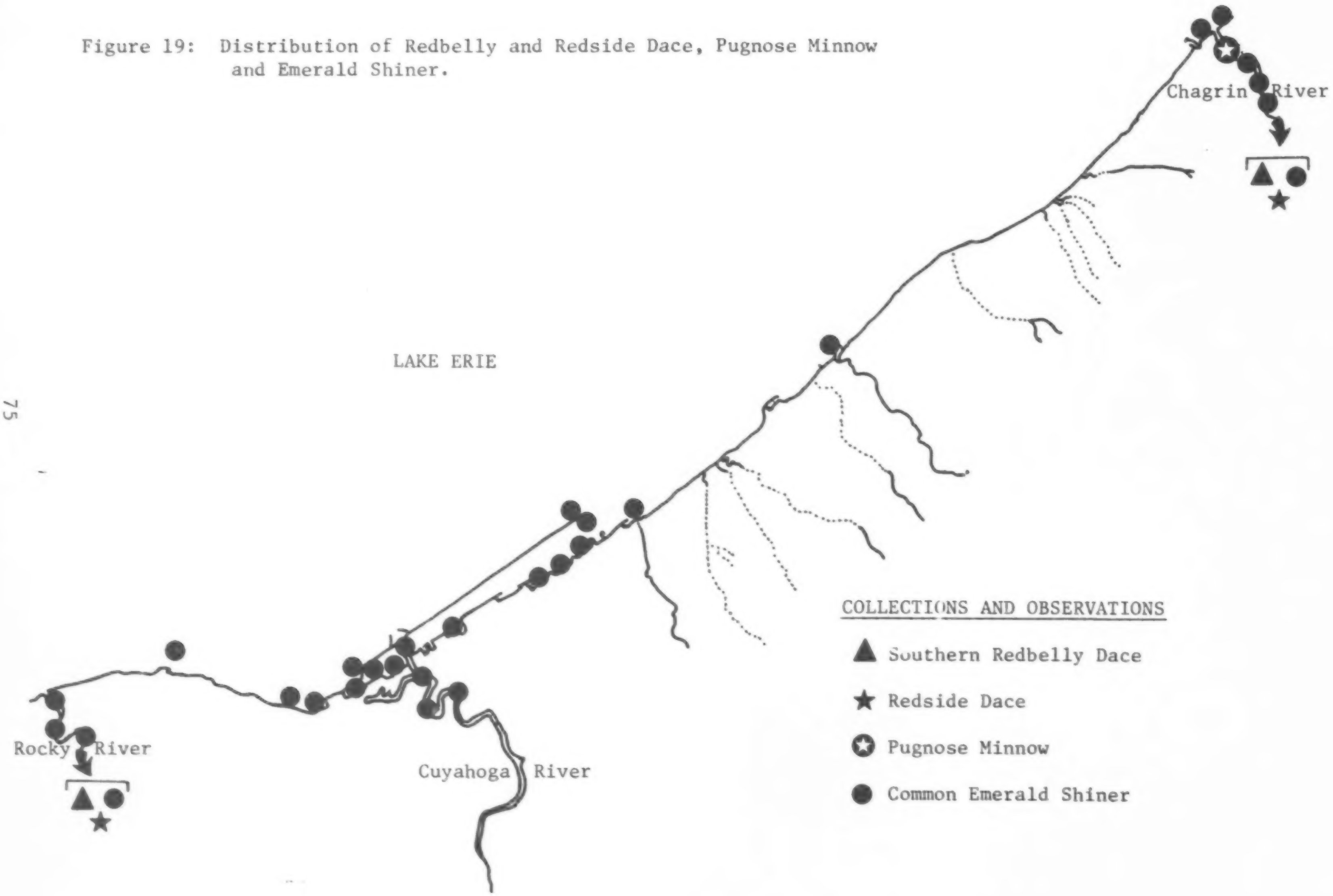
There is no reason to question the early abundance of the Emerald Shiner in Lake Erie prior to 1900. Kirtland (108) recorded an immense concentration (schools several miles long) which occurred on October 9-12, 1853 in the shallows in and near the mouth of the Rocky River.

Between 1900 and 1950 there was no indication of a decline or increase in the numerical abundance of this species.

Currently, this shiner is undoubtedly one of the most important food sources for piscivorous fishes in the study area, not only in Lake Erie, but also in its tributaries. It remains abundant and contributes more than 18 per cent of the specimens collected from the Lake and lower sections of rivers in the Cleveland area during this survey. This shiner is commercially important since it is the primary live bait species utilized by sportsmen when fishing for Yellow Perch. Discussions with bait dealers indicate that there has been a recent decline in abundance of this species. This is supported by Van Meter and Trautman (150) who state that it is "...possibly decreasing in abundance throughout Lake Erie." It would be difficult at this time to determine whether the decline will continue or represents only a temporary population fluctuation. Should this indicate the initiation of a continuing trend, we believe that there would be serious consequences to the loss of such an important forage species in the Cleveland area.

(References; 108, 119, 147, 150, 163)

Figure 19: Distribution of Redbelly and Redside Dace, Pugnose Minnow and Emerald Shiner.



39. ROSYFACE SHINER, Notropis rubellus

COMMON STREAM

There are preserved specimens from the area taken before 1900, and it is assumed that the species was more numerous in the tributaries at that time.

Although some large collections were taken in the tributaries east of the Allegheny Front Escarpment since 1900, the species has obviously become less numerous on the whole and some populations appear to have been extirpated.

The Rosyface was taken, sometimes in considerable numbers, from the middle and upper portions of the Chagrin and Rocky rivers. None was taken in Lake Erie, although it may occur there as a stray. Occasionally this species may serve as a food source for some Lake Erie fishes entering the rivers to feed (such as yearling White Bass).

(References; 147, 150, 163)

40. NORTHERN REDFIN SHINER, Notropis umbratilis

RARE STREAM

Although large-sized populations occurred before 1900 in the Lake Erie tributaries immediately to the east and west, only a few individuals have been recorded from the study area.

Since then and prior to 1955, Redfins have been taken at the mouth of the Chagrin and from the middle section of the Cuyahoga River.

Despite intensive seining, only two specimens were collected during the current survey; one in the lower Rocky River, and the other in the lower Chagrin. Apparently, this species has greatly declined in numbers and appears to be near extirpation.

(References; 119, 147, 150, 163)

41. STRIPED SHINER, Notropis chrysocephalus

ABUNDANT STREAM

In 1847, Kirtland considered the Striped and Common Shiners to be conspecific (71). As a result, no evidence exists indicating which species was the most numerous.

Since 1900, the species was widely distributed throughout the area, but presumably was most numerous in the lower sections of the lake tributaries. During the 1900 to 1970 period, the habitat of the Striped Shiner was apparently increasing, whereas that of the Common Shiner seems to have been decreasing.

Evidence for this change in habitats was observed during this survey. Since 1950, the Striped Shiner has invaded from lower portions of the three rivers, into the middle sections of both the Chagrin and Rocky rivers. Furthermore, specimens collected in the former range of the Common Shiner are predominately hybrids or intergrades between these two species. This would indicate the continuing invasion of the higher gradient tributaries by the Striped Shiner. It is probable that this extension of the range is due to increased siltation, which is favoring the Striped Shiner, the more silt-tolerant of the two. Striped Shiners and their hybrids are most abundant in the lower portions of the Chagrin and Rocky rivers. The species occurs occasionally in Lake Erie as a stray.

(References; 71, 115, 136, 147, 150, 163)

42. COMMON SHINER, Notropis cornutus

LOCALLY COMMON STREAM

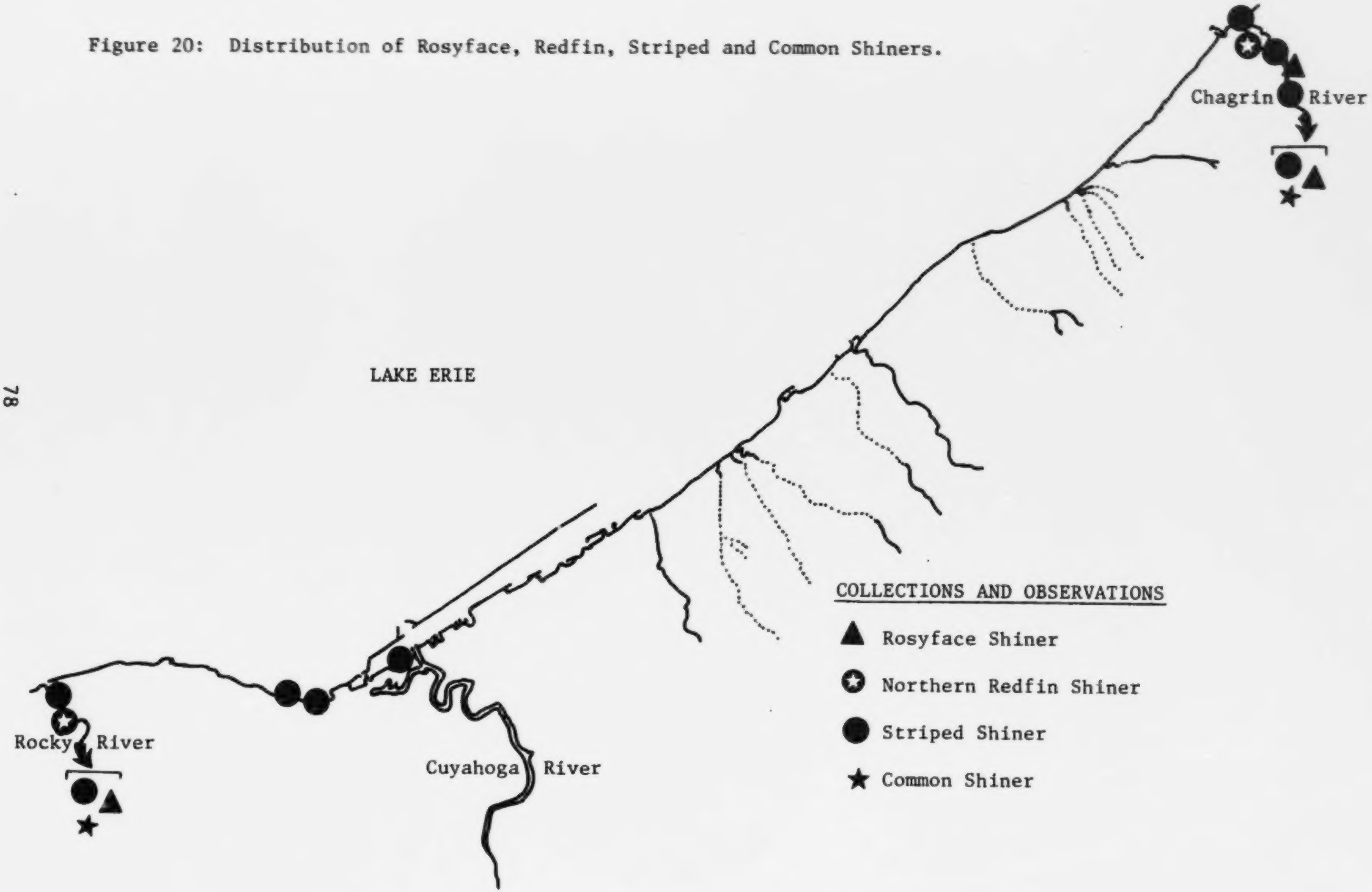
There is no reason to doubt that this species was as numerous, and most probably more numerous in the study area before 1900 than it has been since.

Since 1900, the habitat of this high gradient species has been eliminated in some areas, and it appears to have become less abundant than formerly (See Striped Shiner).

The Common Shiner was collected in limited areas in the upper tributaries of the study area especially in those of the Chagrin River. Confusion exists as to the conspecific identity of this species and the Striped Shiner because of the large numbers of supposed intergrades occurring in some areas, especially in the middle sections of the tributaries. Hybrids between the Common and Striped Shiners with other species such as the Rosyface Shiner and River Chub are frequently encountered in some sections of area streams. Because of the morphological similarity between the Common and Striped Shiners; or their intergrades, it is often impossible to identify the parentage of a natural hybrid; that is whether its one parent was a Striped, Common or intergrade between the two.

(References; 115, 121, 124, 136, 147, 150, 163)

Figure 20: Distribution of Rosyface, Redfin, Striped and Common Shiners.



43. SPOTTAIL SHINER, Notropis hudsonius

UNCOMMON LAKE

In 1845, Kirtland (71) considered this species to be confined to Lake Erie where it was "not uncommon".

There is no reason to believe that there was any change in its abundance before 1900.

The species was quite numerous in Lake Erie until 1925, when it began to demonstrate a definite decline in numbers.

A recent survey of this species in the western basin of Lake Erie has shown a significant decrease in numbers. In the Cleveland area, this shiner has apparently also declined. It was occasionally taken in fair numbers, especially where it was concentrated in the lower rivers but in general, only a few were taken in a sample.

(References; 71, 119, 147, 150, 163)

44. SPOTFIN SHINER, Notropis spilopterus

COMMON STREAM

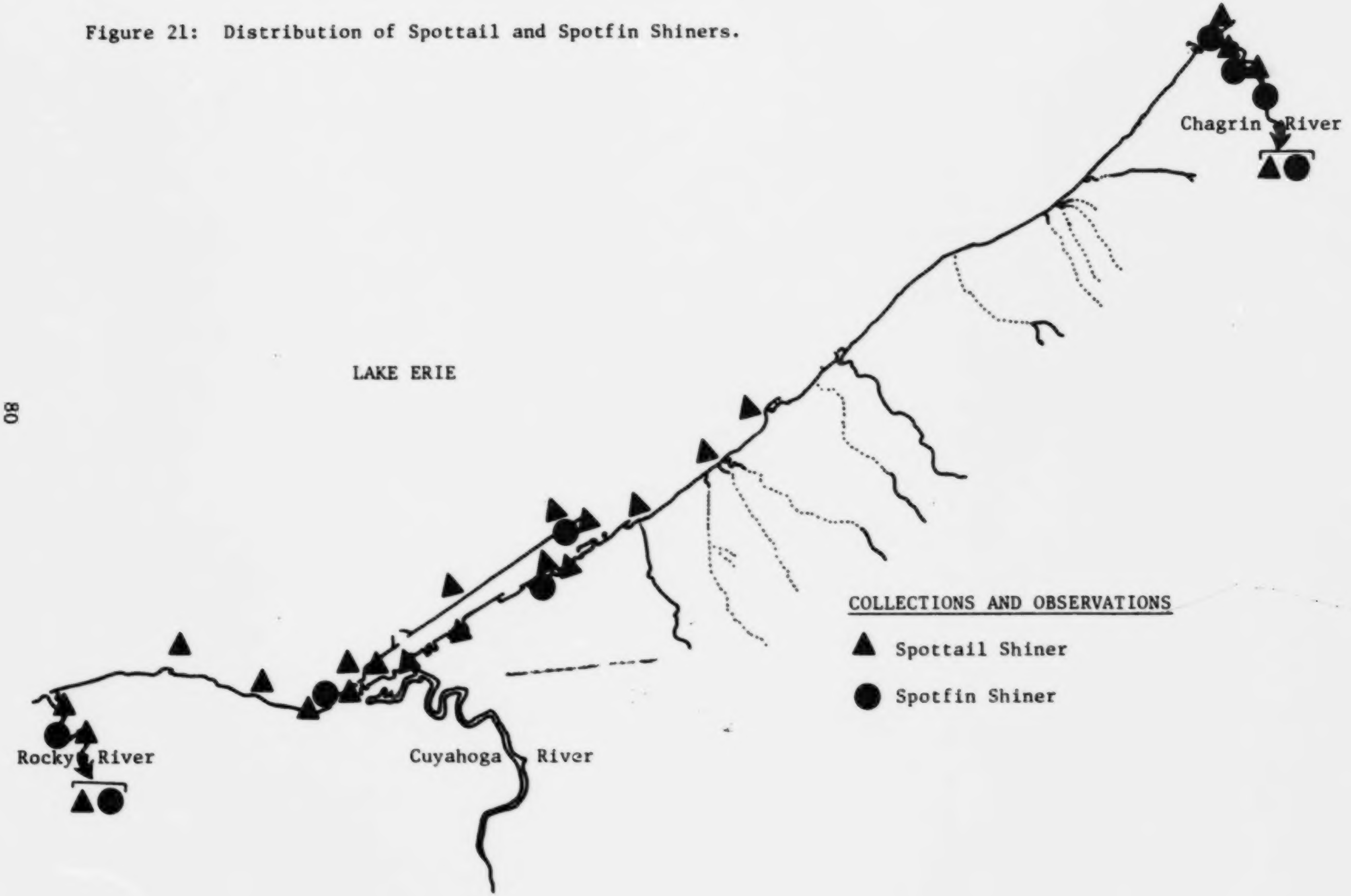
Unquestionably, this species was present throughout historic times; its early abundance is unknown.

After 1900 it was noted throughout the streams of the area and in protected portions of the lake shore. The number of this rather pollution-tolerant species was observed to be increasing in abundance in many localities, especially in the lower portions of the streams north of the Allegheny Front Escarpment (147).

Indications during the present study were that the increased pollution caused a recent reduction in numbers. It was abundant only in the lower and middle sections of the Chagrin River and occurred in limited numbers in the Rocky River. It appears to have become greatly reduced along the shoreline of Lake Erie and in the lower Cuyahoga River. While 3000 of these were collected in the Chagrin and Rocky rivers, only a very few were taken from Lake Erie, this in spite of intensive efforts to collect them.

(References; 119, 147, 150, 163)

Figure 21: Distribution of Spottail and Spotfin Shiners.



45. CENTRAL BIGMOUTH SHINER, Notropis d. dorsalis

RARE STREAM

This species was not recorded in Ohio prior to 1900, but it is assumed that a population was present in the Rocky River throughout much of Columbian time.

It was not until 1922 that it was taken from the East Branch of the Rocky River. This relict Ohio population was never extensive and the largest number taken was a total of 23 individuals in two collections, June 2, 1929 (147).

During this survey, none was found in the East Branch of the Rocky River. One was taken on July 20, 1971, and another, August 16, 1971, in the middle portions of the Rocky River itself; presumably these were strays from a relict population somewhere in the upper Rocky River drainage. Currently the Bigmouth Shiner is known only from the Black and Rocky rivers. These two Ohio populations have been declining rapidly. The species is considered to be an Ohio endangered species and should be protected.

(References; 147, 150, 163)

46. NORTHEASTERN SAND SHINER, Notropis stramineus deliciosus

UNCOMMON UBIQUITOUS

Until 1928, the Sand Shiner was hopelessly confused with other species of shiners. Preserved specimens exist which were taken in Cuyahoga County, and there is reason to believe that the species was numerous before 1900.

After 1900, it was present in fair numbers throughout the Chagrin and Rocky rivers, in a few areas of the upper Cuyahoga drainage, and on the exposed sand and gravel beaches of Lake Erie.

The present study indicates that the largest populations are in the Chagrin River over clean sand-and-gravel substrates. The populations inhabiting the local Lake Erie beaches appear to have been drastically reduced and Sand Shiners are present there only in limited numbers.

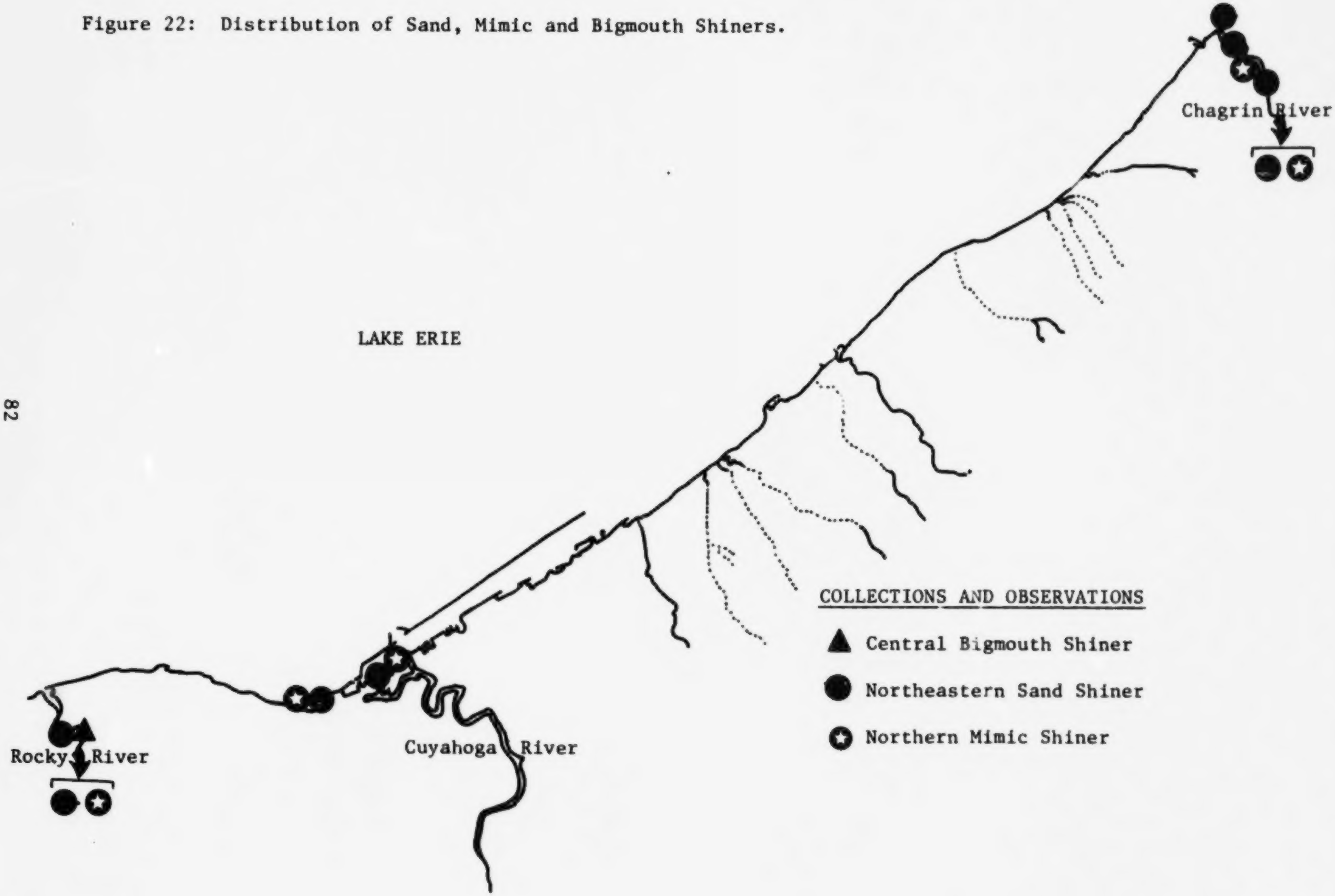
(References; 136, 147, 150, 163)

47. NORTHERN MIMIC SHINER, Notropis v. volucellus

RARE UBIQUITOUS

Literature references prior to 1928 are absent because the Mimic Shiner

Figure 22: Distribution of Sand, Mimic and Bigmouth Shiners.


Chagrin River
LAKE ERIE
COLLECTIONS AND OBSERVATIONS
▲ Central Bigmouth Shiner
● Northeastern Sand Shiner
✪ Northern Mimic Shiner
Rocky River
Cuyahoga River

was hopelessly confused with other shiner species. However, preserved specimens from Cuyahoga County indicate its presence before 1900.

After 1900, large populations were found along the shores and islands of western Lake Erie, and presumably it was present along the shores of the lake in the Cleveland area. It was present in all three tributaries and was most numerous in the Rocky River.

Recently, a great decline has occurred in the Cleveland area and an effort of more than several hundred man-hours of seining streams in its former habitat produced only two specimens, one each from the Rocky and Chagrin rivers. Collections taken on beaches indicate that it has been nearly extirpated; of more than 10,000 cyprinids examined only 12 were Mimic Shiners.

(References; 147, 150)

48. SILVERJAW MINNOW, Ericymba buccata

COMMON STREAM

Since this species was not described until 1865, little is known of its early presence in the area. McCormick (1892), recording it from the streams of Lorain County, considered it rare in the Black River (119), and presumably populations were similar elsewhere in northeastern Ohio.

After 1900, and especially since 1920, the evidence suggests that the Silverjaw has been rapidly increasing in northeastern Ohio.

The Silverjaw Minnow is relatively tolerant to some types of pollutants provided that the sandy substrates remain unsilted. During the survey it was found to be common to abundant in most areas of the Chagrin, Rocky and upper Cuyahoga rivers. In some localities it was the most abundant minnow.

(References; 119, 147, 150, 163)

49. NORTHERN FATHEAD MINNOW, Pimephales p. promelas

UNCOMMON STREAM

A few specimens have been preserved which were collected before 1900, and there is little reason to believe that the species was not present, at least in isolated populations, throughout historic time.

There appears to have been a definite population increase after 1900. Since 1960 it has been increasingly utilized as a bait and forage minnow, and it is assumed that many are inadvertently introduced into streams by anglers.

It was taken, although never in large numbers, from the middle and lower sections of the Chagrin and Rocky rivers, and from the middle section of the Cuyahoga River, notably at Peninsula, Ohio. One was collected along the shoreline of Lake Erie, within the Cleveland Harbor.

(References; 67, 124, 147, 150, 163)

50. BLUNTNOSE MINNOW, Pimephales notatus

ABUNDANT UBIQUITOUS

From the many preserved specimens before 1900 throughout all of Ohio, it is believed that this ubiquitous species was most numerous throughout the area and present along the shoreline of the Lake.

Collections after 1900, demonstrate its almost universal presence in the tributaries of the area and in the Lake. After 1925, it was propagated by the Ohio Conservation Department. Some were released in the study area.

Presently, it is an extremely abundant minnow in tributary streams, but populations along the Lake Erie shoreline have noticably declined. During the survey,it was routinely collected in the streams of the area, and small numbers were taken along the Lake Erie shoreline, mainly in marinas.

(References; 115, 119, 124, 135, 136, 147, 150, 163)

51. STONEROLLER MINNOW, Campostoma anomalum

COMMON STREAM

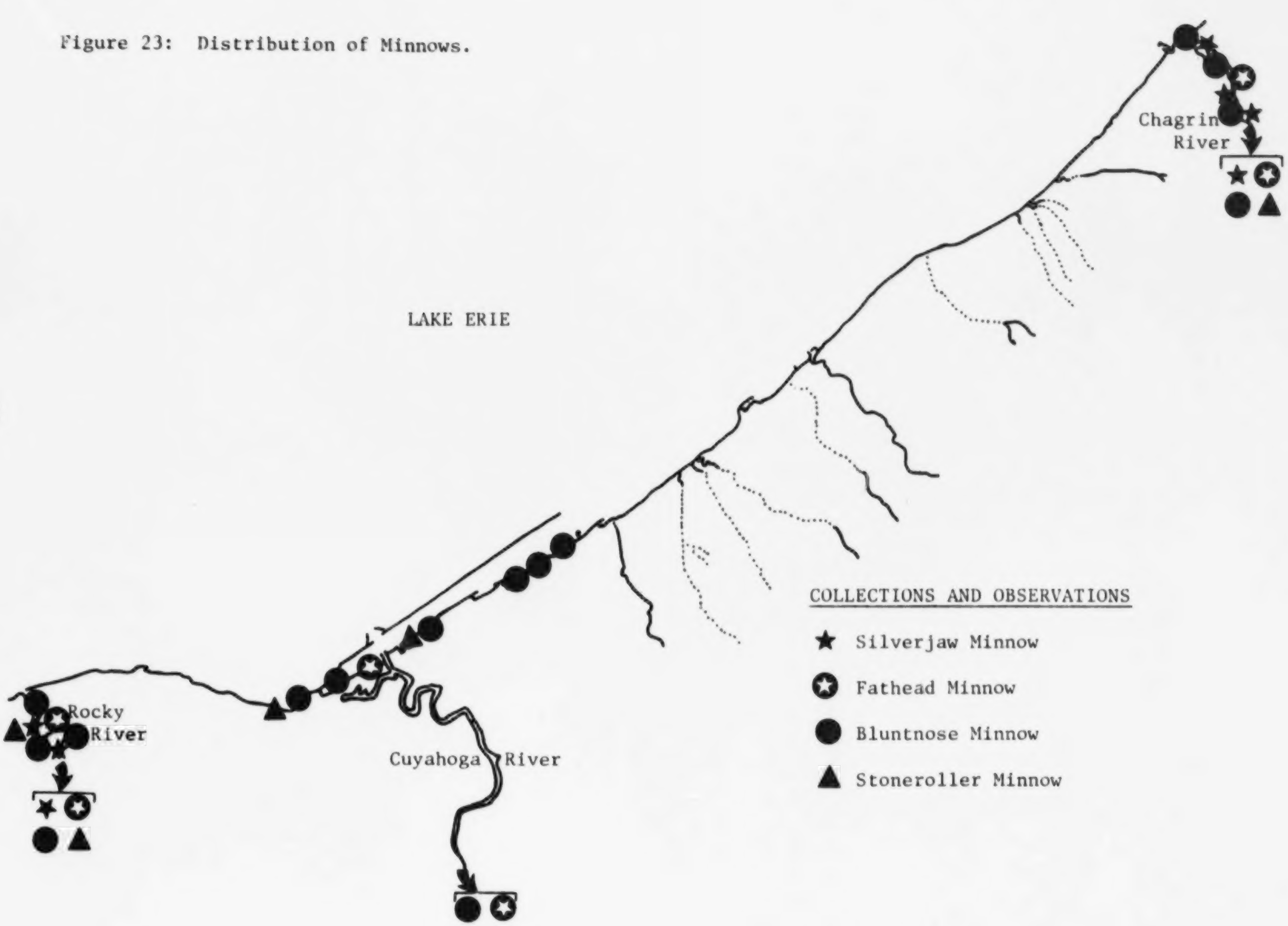
Reviewing the literature, Osburn (125) stated that this stream species was very abundant and widely distributed in Ohio prior to 1900. There is no reason to believe that it was not equally abundant in the tributaries of the study area.

Since 1900, it has been taken commonly throughout the streams of the area.

This high-gradient species was taken from the upper portions of the Rocky and Cuyahoga rivers; and throughout the Chagrin, sometimes in large numbers.

(References; 119, 124, 125, 136, 147, 150, 163)

Figure 23: Distribution of Minnows.



52. BIGMOUTH BUFFALOFISH, *Ictiobus cyprinellus*

PROBABLY EXTIRPATED • LAKE

There is a single specimen in the Harvard Museum of Comparative Zoology collected by Kirtland at Rock Port, Cuyahoga County, in November of 1845 (147).

None have been taken since and the species may be considered to be extirpated in the study area.

(References; 54, 147, 150)

53A. EASTERN QUILLBACK CARPSUCKER, *Carpiodes cyprinus cyprinus*

RARE LAKE

Kirtland stated that he had "...met with it in a few instances in Lake Erie.", referring to it as the shad (102). Evidence before 1900 indicates its presence in Lake Erie and its tributaries.

There appears to have been slight increase in numbers of this subspecies between 1900 and 1960, after which an apparent decrease occurred in the Central Basin.

Although many young-of-the-year Carpsuckers were collected in the lower portions of the rivers during the survey, it is impossible to determine to which subspecies they belong. Two adult *Carpiodes c. cyprinus* were collected in Lake Erie during this survey, and it is assumed that they are rare. Since the population of *Carpiodes c. hinei* is larger, the young-of-the-year collected in the rivers were probably of the *hinei* subspecies. A small number of young-of-the-year Carpsuckers were collected in the Cleveland Harbor during 1974, and during the same year, 3 yearlings were taken near the mouth of the Cuyahoga River. It is possible that the young-of-the-year from the harbor are of the *cyprinus* subspecies.

(References; 72, 102, 119, 147, 150)

53B. CENTRAL QUILLBACK CARPSUCKER, *Carpiodes cyprinus hinei*

UNCOMMON STREAM

Little is known of the abundance of this subspecies prior to 1900 since it was not recognized until 1956. The relatively few records of Quillbacks before 1900 suggests that both subspecies were not numerous.

Since 1900, the subspecies *Carpiodes cyprinus hinei* has been increasing in abundance.

During the present survey, many adults of this subspecies were collected in the lower Chagrin, while fewer were collected from the Rocky River. Apparently, this subspecies continues to increase in abundance.

(References; 72, 102, 119, 147, 150)

54. SILVER REDHORSE, Moxostoma anisurum

SCIENTIFICALLY EXTIRPATED UBIQUITOUS

Although 19th Century ichthyologists failed to satisfactorily separate the various species of the genus Moxostoma, it is believed that the Silver Redhorse was at least as numerous, or maybe more so, before 1900 than it has been since. Conditions were then more favorable.

Since 1900, as well as before, specimens have been taken from the lower portions of the Rocky River.

During the present survey, intensive seining of all habitats produced none and it is assumed to have been extirpated in the area.

(References; 105, 119, 147, 150)

55. BLACK REDHORSE, Moxostoma duquesnei

RARE STREAM

As stated previously, 19th Century ichthyologists failed to separate the suckers of the genus Moxostoma. Therefore, nothing is known relative to its presence or abundance in this area prior to 1900.

It was not until 1930 that the species was generally recognized and although it was not definitely recorded for northeastern Ohio, Trautman believed this species to be present in high gradient streams such as the Chagrin River prior to 1951 (147).

During the survey, 34 specimens of adults and yearlings, were taken in the middle portions of the Chagrin River. Intensive collecting in other streams and in the lake produced no additional specimens. Obviously, the presence of young indicates successful reproduction in the Chagrin River.

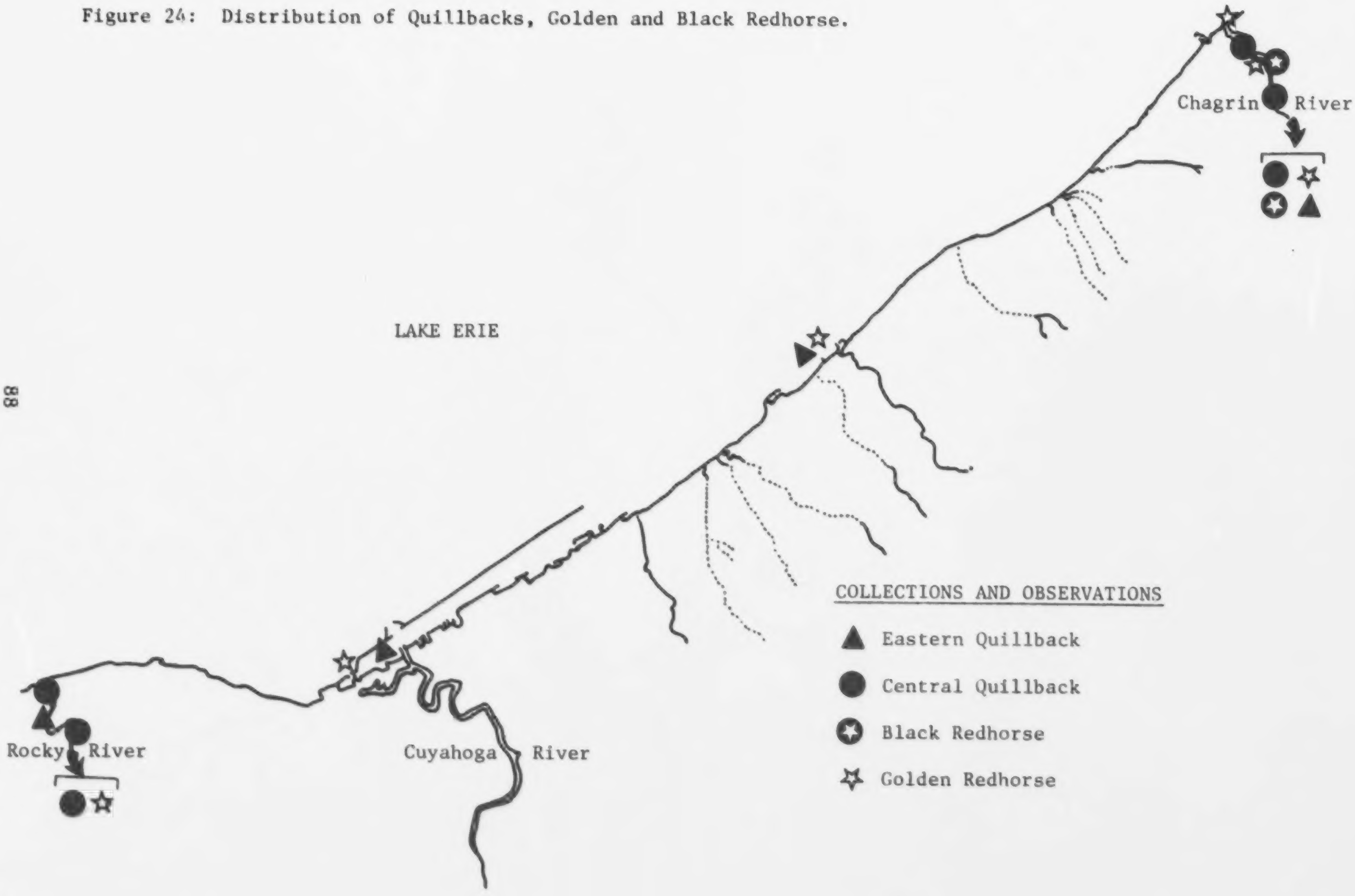
(References; 105, 147, 150)

56. GOLDEN REDHORSE, Moxostoma erythrurum

COMMON UBIQUITOUS

As has been previously stated, early workers failed to satisfactorily

Figure 24: Distribution of Quillbacks, Golden and Black Redhorse.



separate the various species of the genus Moxostoma. It is assumed that the Golden Redhorse was then the most numerous of the redhorses in Ohio.

Since 1920, the species has been the most widely distributed and most abundant of all the redhorses in the streams, whereas in Lake Erie it was surpassed in abundance by the Northern Redhorse.

Results of the current survey indicate that this sucker remains the most abundant redhorse in the streams and may have become the most abundant redhorse species in Lake Erie near Cleveland due to the recent decline of the Northern Shorthead Redhorse.

(References; 105, 147, 150, 163)

57. NORTHERN SHORTHEAD REDHORSE, Moxostoma m. macrolepidotum

RARE LAKE

Despite confusion existing before 1925 relative to the genus Moxostoma, all evidence indicates that this was by far the most numerous redhorse in Lake Erie.

Since 1900 and until recently, it was abundant throughout Lake Erie and was numerous in the Cleveland area. We have observed large catches in the Cleveland fish houses prior to 1955.

Since 1955, the species has declined in numbers and at present it is rare. Only eight specimens were collected during the period of study, all in the open lake. Examination of local commercial catches during 1972 indicate that the species has greatly declined in abundance, and the average daily catch has been only a few specimens.

(References; 94, 119, 147, 150)

58. NORTHERN HOG SUCKER, Hypentilium nigricans

ABUNDANT STREAM

It is evident that the Hog Sucker originally was as numerous in all of the tributaries, including the lower Cuyahoga, as it was throughout Ohio. Since the species prefers the higher gradients, it was most numerous in the upper sections of the streams.

Since 1900, the species has continued to be numerous in these tributaries, except for those areas subjected to pollutants. Occasionally it is taken in the shallow waters of Lake Erie near river mouths where it occurred as a stray.

The Hog Sucker may be readily collected throughout most of the upper Cuyahoga and Rocky river drainages and is abundant in the upper two-thirds of the Chagrin system. A specimen was also collected in the shallows of Lake Erie near the mouth of the Chagrin River.

(References; 92, 104, 115, 119, 124, 136, 147, 150,163)

59. COMMON WHITE SUCKER, Catostomus c. commersoni

ABUNDANT UBIQUITOUS

Kirtland (92), stated that "This species abounds in every permanant stream, lake and pond." Other ichthyologists testify to its universal distribution and great abundance in the tributaries of Lake Erie.

This rather pollution-tolerant species appears to have shown only a slight decrease in numerical abundance since 1900, but it appears that the decline was accelerated after 1950.

At present, the species may be collected in fair numbers in nearly all of the waters within the study area, with the exception of the lower Cuyahoga River. It is reproducing with considerable success in the Chagrin and Rocky rivers. In the early summer, thousands of fry may be collected in a short period of time with little effort.

(References; 92, 104, 119, 124, 135, 136, 147, 150, 163)

60. EASTERN LONGNOSE SUCKER, Catostomus c. catostomus

PROBABLY EXTIRPATED LAKE

In 1878, Klippart (111) recorded this species as occurring in the Ohio waters of Lake Erie.

Although no specimens have been preserved from the Cleveland area, Trautman observed an occasional specimen in the fish houses prior to 1955.

No specimens have been reported from any locality in the Ohio waters of Lake Erie since 1960 and we have not been able to obtain a specimen despite an intensive effort. This species is probably extirpated from the Cleveland area.

(References; 57, 111, 147, 150)

61. SPOTTED SUCKER, Minytrema melanops

RARE STREAM

Kirtland in 1851 (93), stated that the Spotted Sucker "...is abundant in Lake Erie." This was not true after 1900. It is possible that in the early 1800's it was present in numbers in the shallows of Lake Erie in the vicinity of Cleveland when there were clean sand bottoms and aquatic vegetation. There are preserved specimens for the period before 1900.

Since 1900 the species has been taken occasionally in the Rocky and Cuyahoga rivers.

Recently, Orr (124) reported collecting it in the upper Cuyahoga and we have collected specimens there. In 1973 one individual was taken in the lower Chagrin River among dense vegetation. As this species is difficult to capture, it is possible that relict populations may exist elsewhere. None was collected in Lake Erie.

(References; 92, 124, 147, 150)

62. WESTERN LAKE CHUBSUCKER, Erimyzon sucetta kennerlyi

RARE LAKE

Although there are specimens extant from the mouth of the Chagrin River, little else is known concerning this species before 1900.

Since 1960, it has been recorded in the upper Cuyahoga River by Orr (124).

None was collected during this survey. It is possible that it may be present in low numbers in the Chagrin and Rocky rivers.

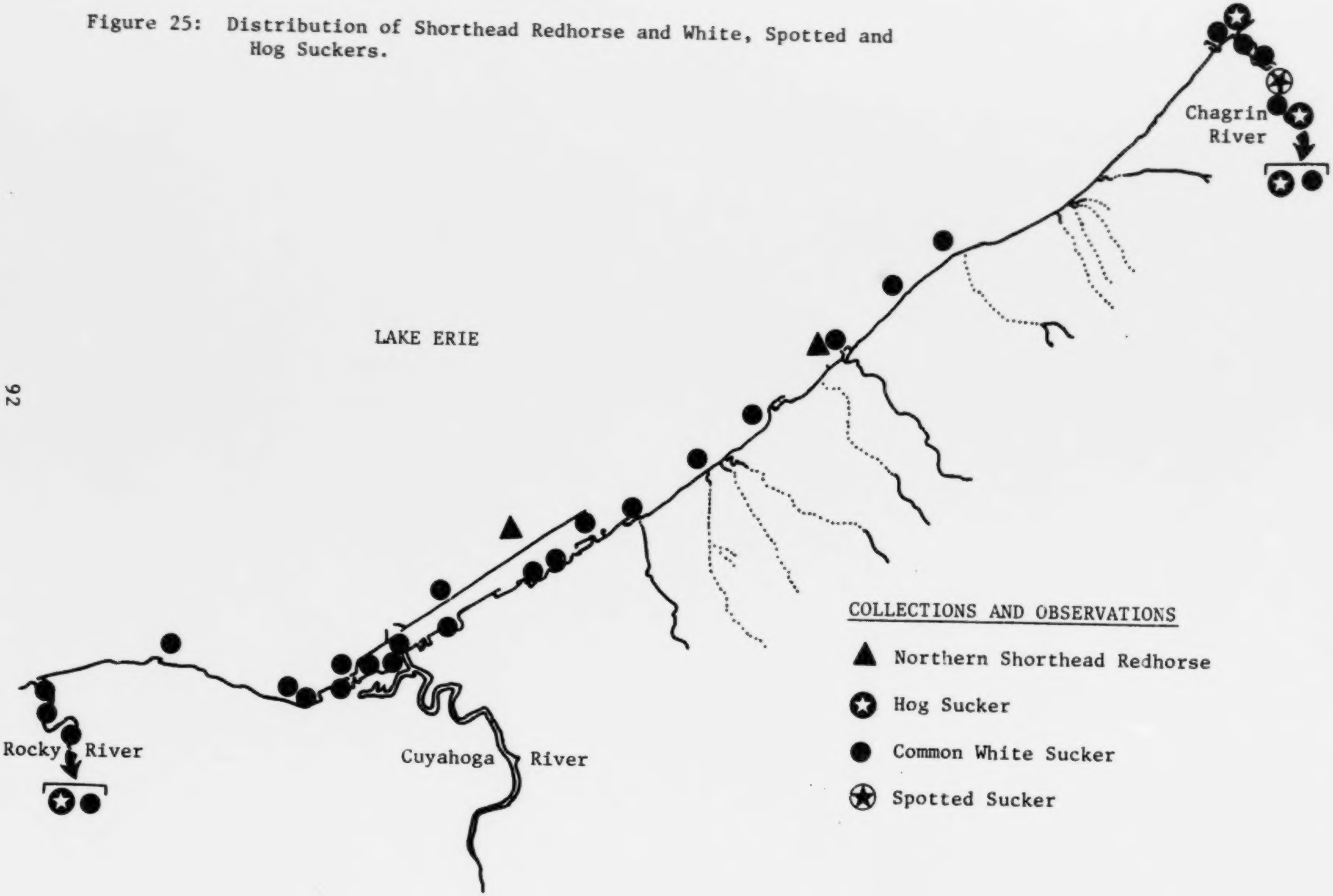
(References; 119, 124, 147, 150)

63. CHANNEL CATFISH, Ictalurus punctatus

UNCOMMON UBIQUITOUS

As early as 1850, Kirtland observed its presence in the Cuyahoga River indicating that it was rather numerous and that the species was "...extensively diffused through the waters of Lake Erie...". He likewise commented on the possible effects of dams upon this highly migratory catfish, stating that it was "...decreasing in numbers in many tributary streams as they are becoming obstructed with mill dams." (79).

Figure 25: Distribution of Shorthead Redhorse and White, Spotted and Hog Suckers.



The species was common to abundant in the area and contributed substantially both to the commercial and sport fisheries between 1900 and 1955.

While Channel Catfish are taken in limited numbers throughout the study area, it is no longer an abundant species. Commercial catches in the open lake have declined. At present, the highest populations occur in and near the lower Chagrin where many young were observed. Significantly lower populations are present along the shoreline and near the Rocky River.

(References; 40, 79, 119, 136, 144, 147, 150)

64. YELLOW BULLHEAD, Ictalurus natalis

COMMON UBIQUITOUS

Records before 1880 were unreliable because of the inability of writers to separate the Yellow from the Brown and Black Bullheads, consequently, its numerical status is unknown. It is assumed, however, that the species was at least as abundant as later, because habitat conditions were more favorable. Preserved specimens from the tributaries taken between 1880 and 1900 are extant.

Between 1900 and 1960 the species was recorded only in the rivers, and until this survey, it had not been collected from the Rocky River. There appears to have been a general decline in numbers.

Throughout the investigation fair populations of this bullhead were found in the lower portions of the Rocky and Chagrin rivers. Individuals were taken in many other localities attesting to its general distribution. The species does not normally inhabit the open lake and only a few specimens were collected from Lake Erie, these from shoreline marinas.

(References; 119, 124, 147, 150, 163)

65. BROWN BULLHEAD, Ictalurus nebulosus

COMMON UBIQUITOUS

As was stated above, little is known concerning the early presence and abundance of the individual bullhead species before 1900. Although the Brown Bullhead's early numerical status is unknown, it is believed to have been at least as numerous before 1900 as it has been since.

Between 1900 and 1965, the Brown Bullhead was the most numerous of the three species of bullheads in the lake. Increased turbidity along the shoreline and in the lower portions of the tributaries, coupled with the disappearance of aquatic vegetation, appears to have reduced its numbers and possibly increased hybridization with the Black Bullhead, as the latter increased.

The largest populations of this bullhead are presently confined to the lower portions of the Chagrin and Rocky rivers although many of these are Brown X Black bullhead hybrids. Most of the specimens from other areas, and many from the lower rivers as well, show massive hybridization with the Black Bullhead. It appears at this time that Brown Bullheads are declining in numbers, at least as a pure species.

(References; 73, 119, 124, 147, 150, 163)

66. BLACK BULLHEAD, Ictalurus melas

COMMON UBIQUITOUS

Although there was considerable confusion in the identification of the three species of bullheads before 1900, preserved specimens testify to the presence of the Black Bullhead in the tributaries and shallow waters of Lake Erie in this area.

The species was recorded, sometimes in considerable numbers, in the tributaries since 1900. It is believed that, as elsewhere, the species has been increasing in abundance with the increase in the amount of its habitat, (perhaps since 1850 according to Kirtland), (78). It is the most tolerant of the three bullhead species to turbidity and pollutants.

Most of the specimens collected during this survey were taken from the middle and lower portions of the rivers, including the Cuyahoga River near Peninsula. Populations also occur in the Lake Erie marinas and in Cleveland Harbor. As has been previously pointed out, the Black Bullhead freely hybridizes with the Brown.

(References; 78, 115, 119, 124, 136, 147, 150, 163)

67. FLATHEAD CATFISH, Pylodictis olivaris

PROBABLY EXTIRPATED LAKE

By 1850 Kirtland had not found this species in the waters of Lake Erie. McCormick recorded relict populations from the Ohio waters of the Central Basin of Lake Erie in 1892 (119).

Between 1900 and 1950, there was apparently no change in the numerical status of this species, and it **remained** rare in the area; however, a small population has been recorded from the Huron River where a few individuals are captured annually (147).

None was collected during this survey and no recent captures have been reported by commercial fishermen in the area. The Flathead is probably absent from the Cleveland area.

(References; 86, 119, 147, 150, 161)

68. STONECAT MADTOM, Noturus flavus

COMMON UBIQUITOUS

Many specimens preserved before 1900 indicate that the Stonecat was present in the area and throughout the remainder of Lake Erie. Because it was not commercially valued, little is known of its numerical abundance. It is believed to have been numerous in Lake Erie near Cleveland.

Throughout the 1900-1950 period, the species was present in the tributaries and Lake Erie and quite numerous in the latter.

The many specimens collected during our survey indicate that it was numerous along the Cleveland shoreline. It was present in smaller numbers in the middle portions of the Chagrin and Rocky rivers, where it inhabited moderately swift riffles with a substrate of gravel, boulders and bedrock.

(References; 73, 119, 147, 150)

69. BRINDLED MADTOM, Noturus miurus

PROBABLY EXTIRPATED STREAM

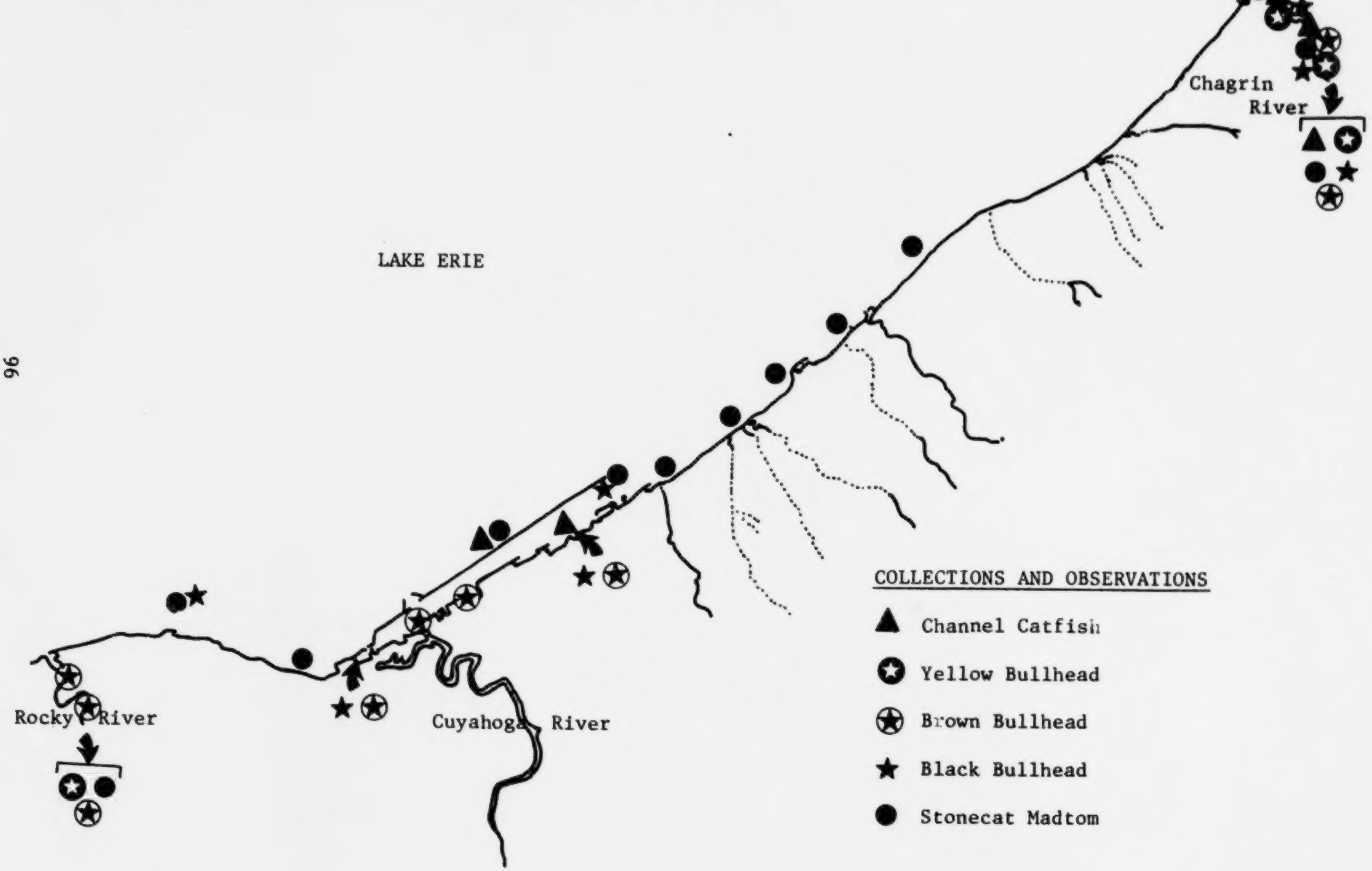
Although preserved specimens are lacking, it is assumed that this species was present in Lake Erie and its tributaries in this area before 1900.

Between 1900-1950, the Brindled Madtom was recorded in the upper Cuyahoga River. Although no specimens are extant from this area of Lake Erie, the species was common in the shallows about the Bass Islands and therefore, was assumed to have been present, at least in low numbers, in the Cleveland area.

None was collected during the survey despite many hours of seining. It is assumed that the species is scientifically extirpated, although possibly, a very low population might exist in the Chagrin River in isolated localities.

(References; 62, 119, 147, 150)

Figure 26: Distribution of Catfish, Bullheads and Madtoms.



70. TADPOLE MADTOM, Noturus gyrinus

PROBABLY EXTIRPATED STREAM

Although literature references and preserved specimens of this small-sized and relatively secretive species are lacking, it is assumed that the Tadpole Madtom was present in the area and was numerous. The extensive dredging, ditching and draining of the shoreline marshes, and depletion of aquatic vegetation destroyed its habitat early in the 1900's.

Since 1900, a few have been taken from the lower portions of the Chagrin River in cattail marsh near its mouth.

As with the previous species, this madtom was not found during the survey. It is possible that it is extirpated, since its preferred habitat has been almost completely eliminated within the Cleveland area.

(References; 119, 147, 150)

71. TROUT-PERCH, Percopsis omiscomaycus

SEASONALLY ABUNDANT LAKE

Jordan and Evermann in 1896 (59) considered the Trout-perch to be abundant in Lake Erie. There is no reason to question their statement.

After 1900 and until recently, in the colder periods of the year, the Trout-perch was numerous in the shallows of Lake Erie in this area, ascending a short distance into the tributaries.

During 1972 and 1973, the Trout-perch was collected between February and May. It was present in all areas along the shore but was not taken in the lower rivers. It was especially numerous in Cleveland Harbor and in marinas where it spawned. A few young-of-the-year were collected during the summer months in the Cleveland Harbor. Adults were not taken in the study area during summer, fall or early winter. Apparently they retreat to the deeper portions of Lake Erie.

(References; 59, 119, 147, 150, 163)

72. EASTERN BURBOT, Lota lota lacustris

RARE LAKE

Kirtland stated (99) that this species was "...abundant in the waters of Lake Erie" prior to 1900.

After 1900 and until at least 1955, the Burbot remained an abundant species. In 1917, 171,929 lbs. were brought into Cuyahoga County ports, even though it was not considered to be a valuable commercial species (40). Later it became increasingly sought after by sport fishermen, especially during the colder weather months. Its initial decrease in abundance was evident soon after 1960.

During the study, only occasional specimens were reported by commercial fishermen in the area. We collected three individuals during the winter months, all in the vicinity of Cleveland Harbor. The species probably occurs in very limited numbers along the shoreline from January to March, spawning near the river mouths. The Burbot is currently an Ohio endangered species.

(References; 59, 119, 147, 150, 163)

73. BROOK STICKLEBACK, Culaea inconstans

LOCALLY COMMON STREAM

Kirtland in 1850 (89), stated that the Stickleback has been found in tributaries of Lake Erie. We assume that some of these streams were in the Cleveland area. In 1882, Jordan (57) stated that it was "...very abundant in many streams in the Northern part of Ohio."

The species was repeatedly recorded after 1950 in the tributaries of the Cuyahoga and Chagrin rivers. It appears to have decreased in abundance because of destruction of habitat by ditching, draining, and channelization.

The destruction of its habitat is continuing and at present the species is primarily limited to a relatively few swamps and ponds within the drainages of all three rivers. Within these areas, Sticklebacks are abundant, and many hundreds may be collected in a single day with a small seine.

(References; 57, 65, 89, 115, 119, 147, 150, 163)

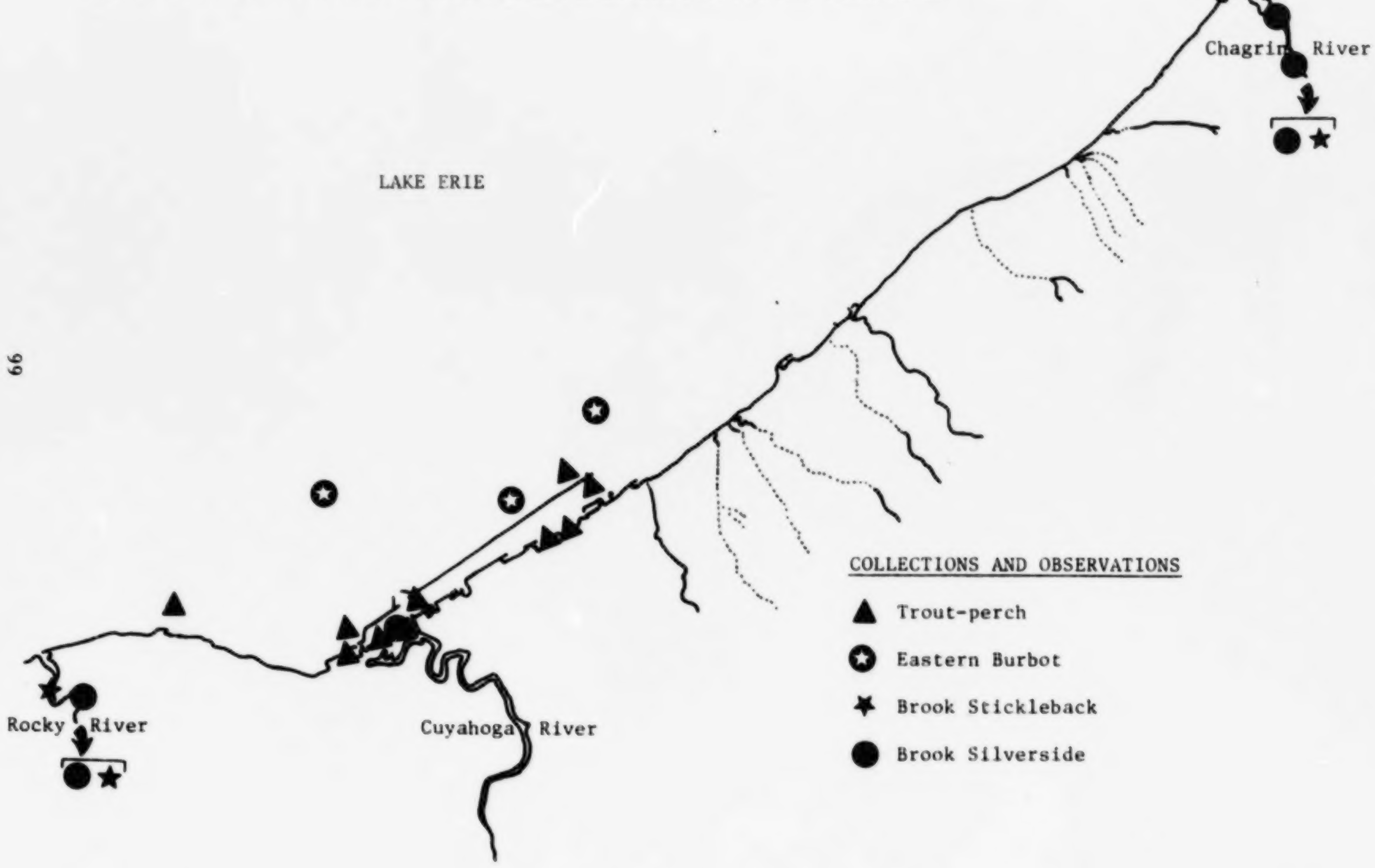
74. BROOK SILVERSIDE, Labidesthes sicculus

RARE UBIQUITOUS

The abundance of preserved specimens from the Rocky, Cuyahoga and Chagrin rivers indicate the general distribution of the Silverside in this area before 1900. McCormick (119) also stated that it was common "...in the Lake.", during his study in 1892.

Shortly after 1900 it became apparent that the Silverside was decreasing

Figure 27: Distribution of Trout-Perch,Burbot,Stickleback and Silverside



in numbers in the tributaries and in Lake Erie. This was probably due to the destruction of its preferred habitat; clear waters and vegetated shallows.

This decrease in abundance continues. During the survey it was taken in only 10 collections. It was present in limited numbers in the lower Chagrin and Rocky rivers, and along the shoreline in the Cleveland Harbor. It is assumed that the decline in numbers began before 1900 and will continue.

(References; 62, 119, 124, 147, 150)

75. WHITE BASS, Morone chrysops

ABUNDANT UBIQUITOUS

Klippart (111) reported that in 1830, this species was captured with shore seines and with hook and line and "...were then most numerous."

Since 1900, the species has been abundant. In 1922, 37,286 lbs. were brought into Cuyahoga County ports. Between 1939-49, the commercial catch from Ohio waters of Lake Erie averaged 549,510 lbs. per annum.

Currently, the species is abundant in Lake Erie and occasionally in the lower portions of the Chagrin and Rocky rivers. Great concentrations of White Bass may be observed during certain times of the year near warm water outfalls, such as the one near Gordon Park. Together with the Yellow Perch it comprises the major portion of the sport and commercial fishing catch in the Cleveland area. The species is reproducing successfully in this area as evidenced by the presence of fry and yearlings at nearly all Lake and lower river sampling sites.

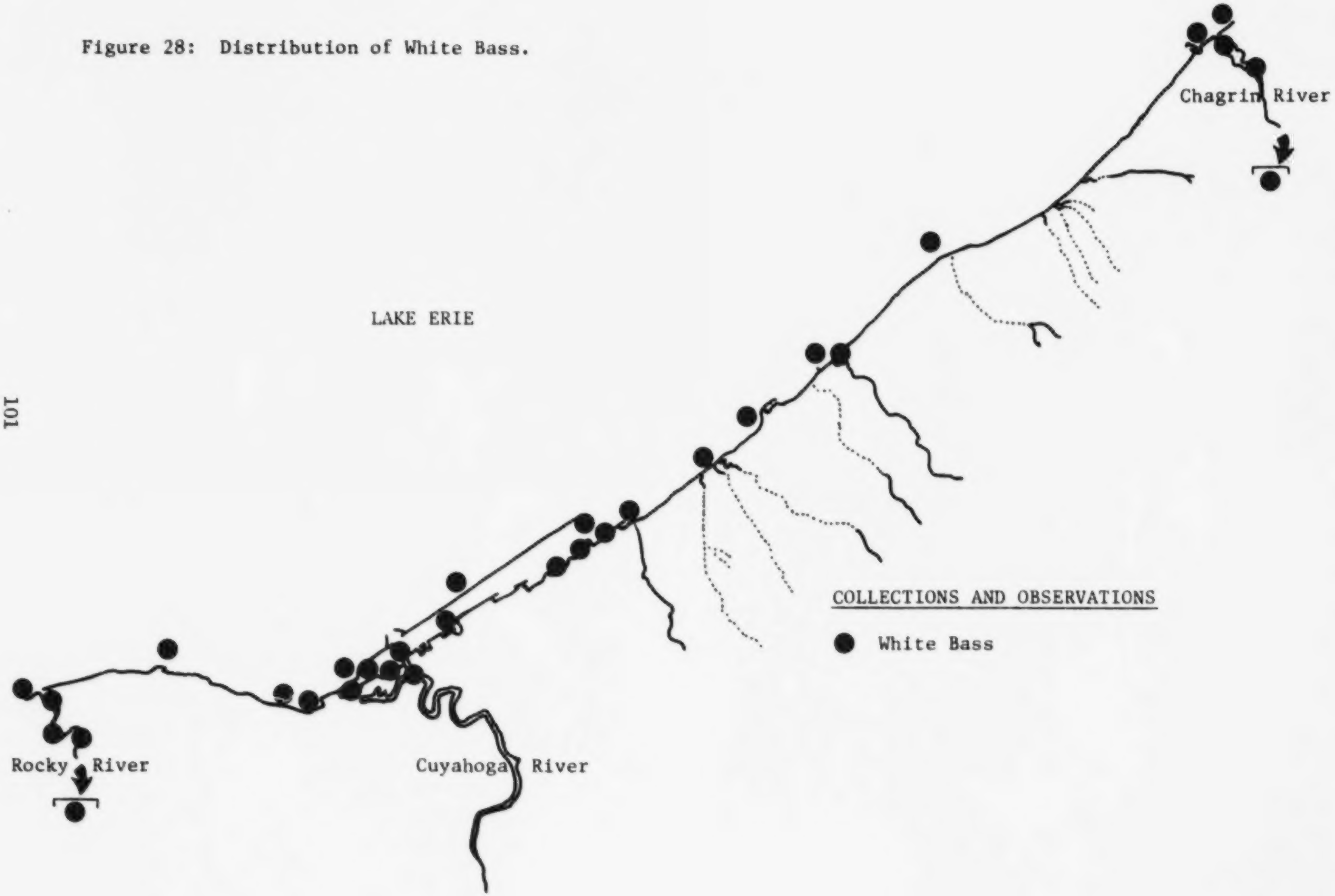
(References; 71, 81, 111, 119, 132, 144, 147, 150, 163)

76. WHITE CRAPPIE, Pomoxis annularis

COMMON UBIQUITOUS

In 1850, Kirtland (82), did not separate the two species of Crappies, referring to them collectively as Centrarchus hexacanthus. His drawing is that of the present species. He stated that "Lake Erie seems to be its most prominent resort..." and that considerable numbers are often taken "...in the vicinity of Cleveland." There is no reason to believe that it was not present in large numbers in the tributaries and the Lake adjacent to Cleveland. After 1875, the White and Black Crappies were usually separated in literature, and the White Crappie was considered to be less abundant in Northern Ohio than the Black Crappie.

Figure 28: Distribution of White Bass.



Since 1900 , the species has been numerous in the streams of the area and many thousands have been captured in Lake Rockwell and liberated elsewhere in Ohio.

Currently this species may be commonly collected throughout the Chagrin, Rocky and upper Cuyahoga rivers, but at present it occurs in fewer numbers in Lake Erie, principally in marinas.

(References; 82, 115, 119, 124, 136, 147, 150, 163)

77. BLACK CRAPPIE, Pomoxis nigromaculatus

UNCOMMON UBIQUITOUS

Little is known concerning the abundance of the Black Crappie in the area prior to 1900 because of confusion with the White Crappie. It is the general opinion of ichthyologists, commercial fishermen and others that the Black Crappie was more numerous than the White, and this may well have been true when there was an abundance of aquatic vegetation and less turbidity.

After 1900, the species was locally abundant in the tributaries and the Ohio Department of Natural Resources liberated many thousands of adults throughout Ohio waters. These had been taken from such lakes as Meander and Rockwell, in the upper Cuyahoga.

Results of our survey indicate that the species had drastically declined and in most areas the White Crappie was now more abundant than the Black. This is especially true of the lower rivers and harbors along the Lake Erie shoreline. Large populations existed only in artificial reservoirs and in heavily vegetated sections of the streams.

(References; 82, 119, 124, 147, 150, 159)

78. NORTHERN ROCKBASS, Ambloplites r. rupestris

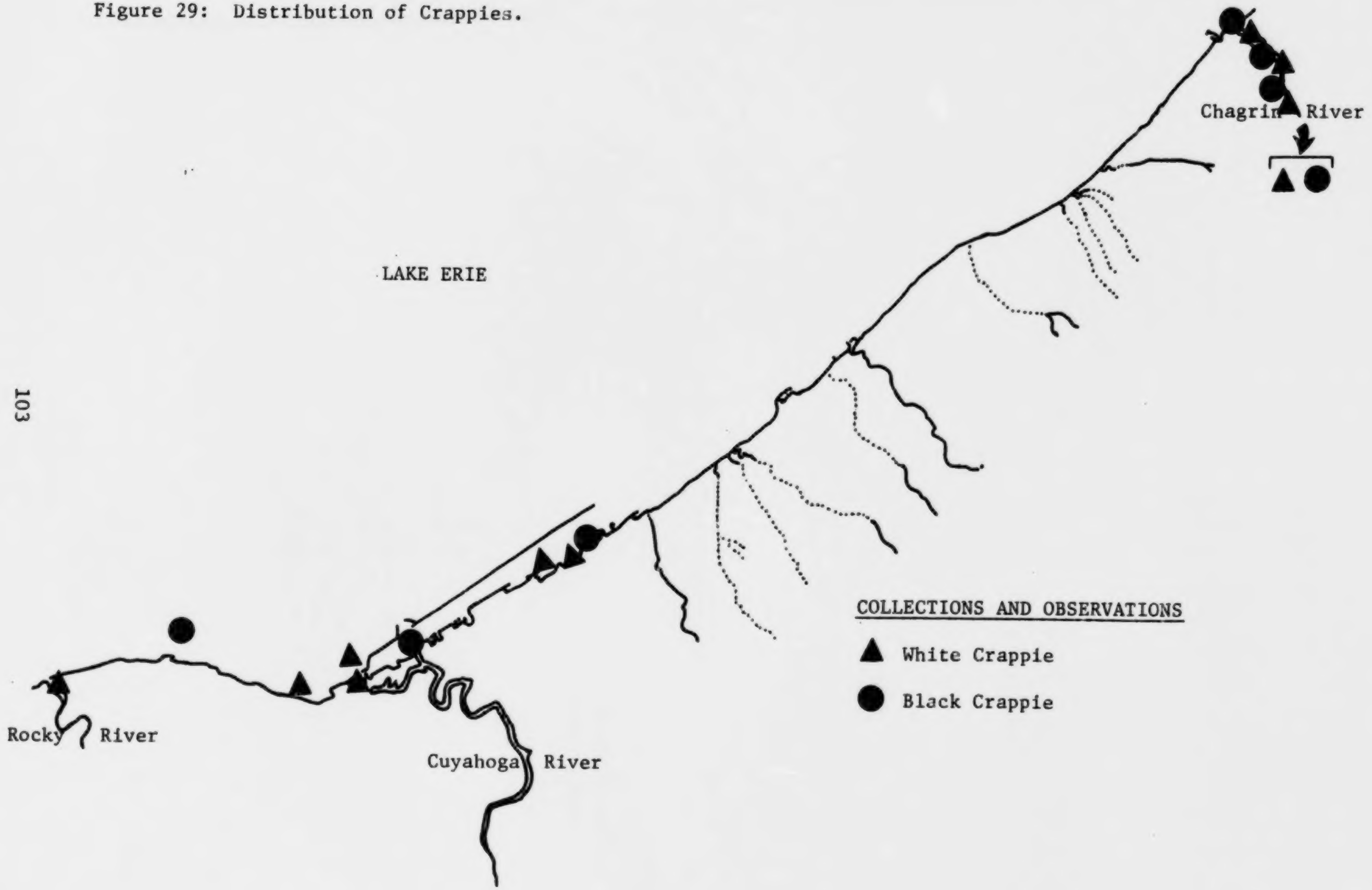
COMMON UBIQUITOUS

Many preserved specimens collected between 1853-1900 and many literature references leave us no doubt as to the great abundance of Rockbass in inland Ohio and in Lake Erie.

Between 1900 and 1965 it was common to abundant in the streams of the area but little is known of the Lake Erie population during this period.

During this study, the species was found to be uniformly distributed but not immensely abundant. Very small populations occurred about the

Figure 29: Distribution of Crappies.



breakwalls of the Lake Erie shoreline, including the Cleveland Harbor. The largest populations were found in the upper two-thirds of the river drainages. It is believed that the species is declining in numerical abundance.

(References; 67, 69, 87, 115, 119, 124, 147, 150, 163)

79. NORTHERN SMALLMOUTH BLACKBASS, Micropterus d. dolomieui

UNCOMMON UBIQUITOUS

The many preserved specimens and innumerable literature references attest to the great abundance of this species in Lake Erie and inland Ohio streams. Kirtland stated that it was "...a valued source of food and was captured with hooks and lines, seines, nets, spears and guns." (71). They were particularly vulnerable to capture because of the clarity of the water, especially by spearing. After 1810, when hundreds of dams blocked the upstream migrations, they were taken in huge numbers with seines in the pools below dams, and later, while migrating downstream, were caught in cribs and weirs placed on the openings of dams. Kirtland mentioned that between 1849-1851, the waters were "...literally black with fishing boats.", these boats containing hook and line fishermen. Frequent catches of one hundred walleyes and smallmouths were taken in a morning by a single person. During the latter part of this period, a considerable decrease in abundance in Lake Erie was noted (see history section).

In 1902, commercial fishing of this species was prohibited in Lake Erie, but the decline in abundance continued (147).

At present, the once immense populations near the mouth of the Cuyahoga River and along the lake shore, have disappeared. To the best of our knowledge, not a specimen of Smallmouth was taken from the Cleveland-Lake Erie shoreline during our 18 month survey by our crews, sport or commercial fishermen. Populations do exist, however, in the upper Cuyahoga River, the upper and middle portions of the Rocky River and in all of the Chagrin River drainage, the largest populations remaining in the middle portion of the Chagrin River. The Smallmouth has been very adversely affected by mill dams, drainage, municipal and industrial pollutants, etc., and has demonstrated a drastic decline in numbers. It is probable that, unless corrective measures are taken to abate these pollutants, the decline will continue.

(References; 35, 71, 91, 119, 136, 147, 150, 161, 163)

80. NORTHERN LARGEMOUTH BLACKBASS, Micropterus s. salmoides

COMMON UBIQUITOUS

Preserved specimens and reliable literature references testify to the presence before 1900 of the Largemouth Blackbass in weedy bays, harbors, marshes and shallows of Lake Erie and the base- and low-gradient portions of its tributaries.

Preserved specimens after 1900 indicate that the species was numerous in the tributaries of Lake Erie and shallow waters in this area. Many were captured in Lake Rockwell and liberated elsewhere in Ohio. During this period the overall numerical abundance continued to decrease in the shallows of Lake Erie. Between 1930 and the present, many thousands of farm ponds were constructed in inland Ohio and those in this area usually contained this species. Escapes from farm ponds continually replenished the tributaries.

Presently the greatest concentration of this species continues to be in the heavily vegetated reservoirs of the upper Cuyahoga River. In other areas, such as the lower portions of the streams and lake shore, the population has greatly declined in numbers even though the species is more silt-tolerant than is the Smallmouth Blackbass. In areas such as Cleveland Harbor and Edgewater Marina, where the Smallmouth has apparently been extirpated, small populations were observed, especially in the marinas, to be nesting and young-of-the-year were collected from areas in the Cleveland Harbor. The limited reproductive success of this species was apparently further hampered by sports fishermen who removed the adults while they were tending their eggs in shallow water, a time when they were most conspicuous and vulnerable to capture. On June 29, 1972 we observed more than 30 nests that were tended by adults in the Edgewater Marinas; within three days, all of these had been removed by anglers. Considering the precarious state of the species in this area, such a removal of spawning adults may have serious deleterious effects.

(References; 111, 115, 119, 124, 135, 136, 147, 150, 163)

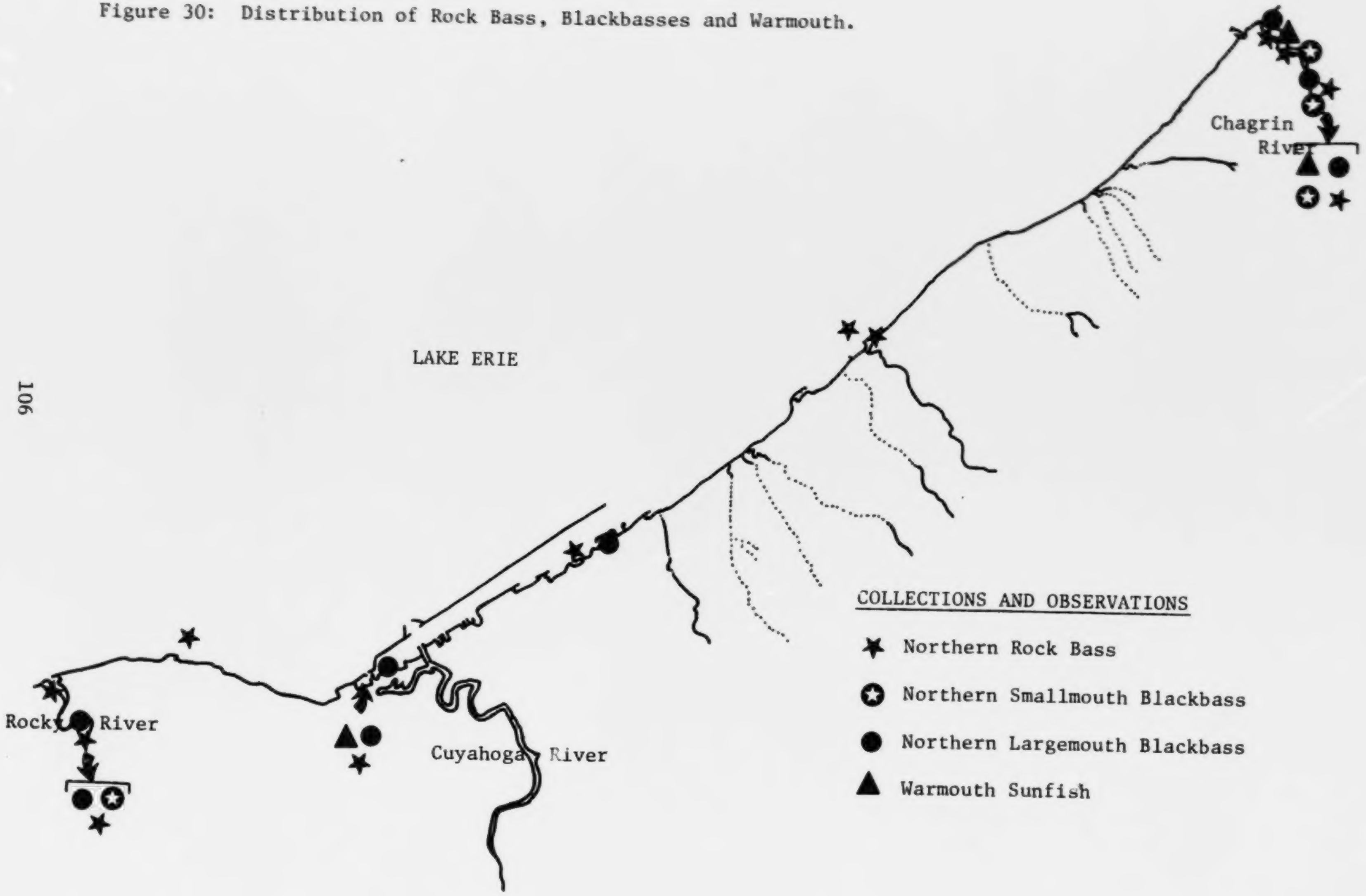
81. WARMOUTH SUNFISH, Lepomis gulosus

UNCOMMON STREAM

Although this species must have been present in the tributaries and shallows of Lake Erie before 1900, no specimens had been reported or preserved from this area.

Since 1900, Warmouth has been repeatedly taken in the Chagrin and Cuyahoga rivers and was not uncommon in Lake Rockwell (147).

Figure 30: Distribution of Rock Bass, Blackbasses and Warmouth.


LAKE ERIE
Chagrin River
Cuyahoga River
Rocky River
COLLECTIONS AND OBSERVATIONS
★ Northern Rock Bass
✪ Northern Smallmouth Blackbass
● Northern Largemouth Blackbass
▲ Warmouth Sunfish

Small populations persisted in the upper and middle portions of the Chagrin River drainage and in the upper Cuyahoga River as well. This species was not abundant in the rivers. Rarely are more than a few taken at a time even then only in an occasional collection. One individual was collected in Lake Erie; taken in the Edgewater marina. Presumably this specimen was a stray, as the species does not inhabit Lake Erie.

(References; 124, 147, 150)

82. GREEN SUNFISH, Lepomis cyanellus

COMMON STREAM

Preserved specimens and reliable literature references indicate that previous to 1900, the Green Sunfish was present in this area, was generally distributed and usually numerous from Cleveland westward.

Since 1920, the species was present in all of the tributaries in the area, and apparently its numbers were increasing.

This Centrarchid is apparently one of the most pollutant-tolerant of Ohio Sunfish species and was taken in large numbers in locations where other species were few or absent. In areas of cleaner waters, less silted substrate, and/or with aquatic vegetation, other sunfish species usually far outnumbered the Green in abundance. It is our opinion that the relative populations of sunfish species may be used as general indices of water quality. Current survey indicates that populations of Green Sunfish were low in the Chagrin River moderate in the Rocky River; and in the middle Cuyahoga River it was the predominant sunfish.

(References; 119, 124, 136, 147, 150, 163)

83. BLUEGILL SUNFISH, Lepomis m. macrochirus

COMMON STREAM

Specimens, captured before 1970, have been preserved from every Ohio county bordering Lake Erie, and they, together with reliable literature records, indicate its presence in Lake Erie and tributary streams. It was abundant and of importance as a sport fish after 1900 and was found generally throughout the area. After 1920, thousands were removed from Lake Rockwell and liberated elsewhere. The building of hundreds of farm ponds in the area, almost all containing Bluegills, some of which escaped, helped to maintain stream populations.

While the Bluegill population in the area streams remained relatively high, we found that in general, stream populations were considered by many persons to be much higher than they actually are. This is probably due to the difficulty encountered by the public in discriminating between the various species of sunfishes especially when dealing with immature or hybrid specimens. Often, the classification of "bluegill" is indiscriminately applied to an immature specimen of Pumpkinseed or Green Sunfish. If, as we have previously stated, sunfishes are to be used as indicators of water quality, then it is essential that these species be correctly identified.

It was noted that Bluegill populations were high in the Rocky and upper Cuyahoga drainages and moderate in the Chagrin River. A few were collected in Lake Erie at Edgewater Park and in the Cleveland Harbor,where it occurred in low numbers. In such areas, the Pumpkinseed is far more numerous.

(References; 115, 119, 124, 135, 136, 147, 150, 163)

84. ORANGESPOTTED SUNFISH, *Lepomis humilis*

RARE STREAM

This species has been invading Ohio from the west since 1920 (147). None was found in the study area previous to this survey.

This sunfish is the most silt-tolerant of the Ohio sunfishes. Its invasion eastward was apparently due to the extensive siltation of the waters which is probably creating less favorable habitat for other Centrarchids. The few individuals collected during this study are the first records of the species in this area. Together with other recent unpublished records from southeastern Ohio, the Cleveland area specimens represent a significant extension of this species' range eastward in Ohio. Previously, this species was recorded only from western Ohio streams; the easternmost Lake Erie tributary was near Sandusky. It is our opinion that the populations of this sunfish in the Chagrin River will increase in the future.

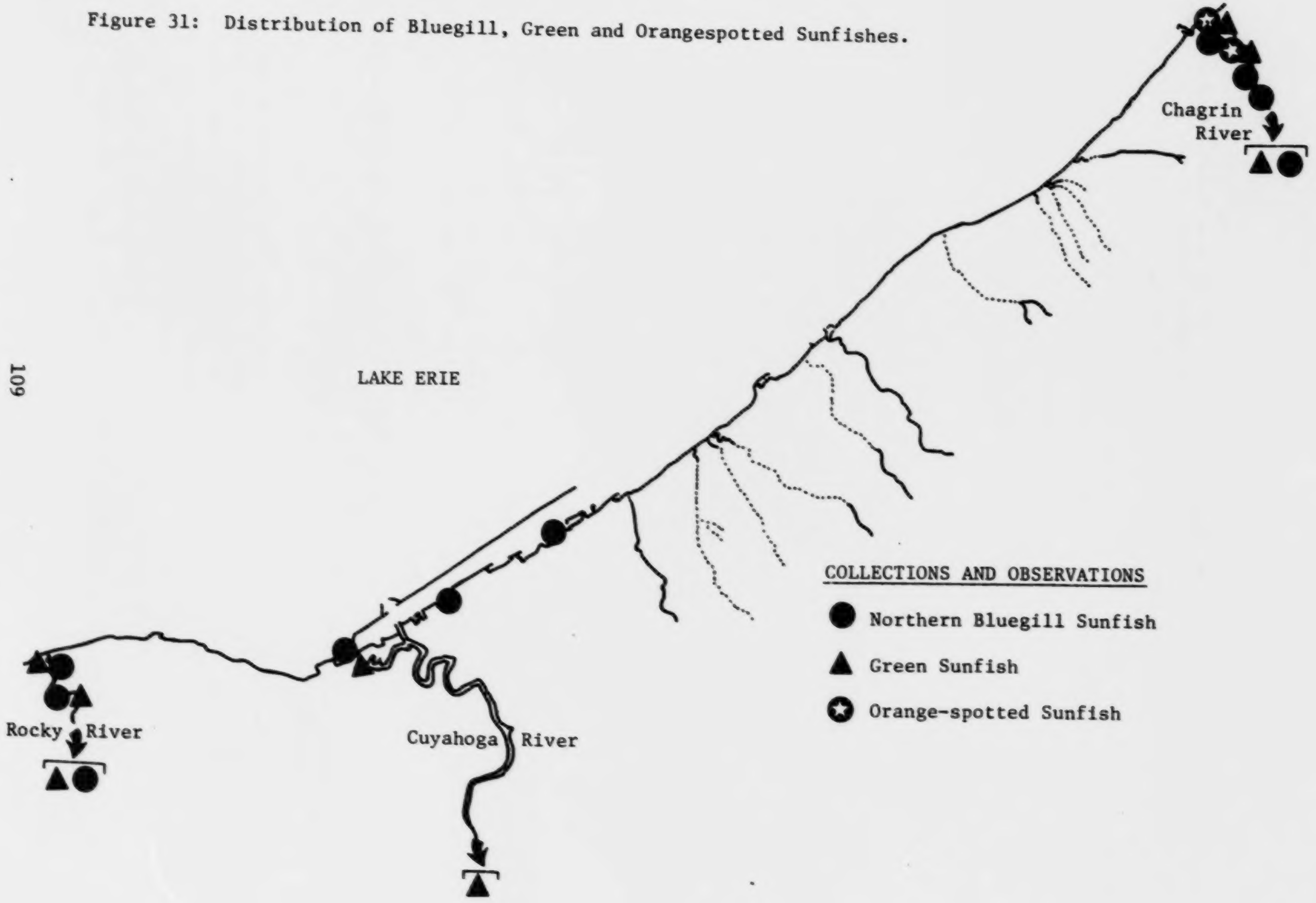
(References; 58, 147, 150)

85. NORTHERN LONGEAR SUNFISH, *Lepomis megalotis peltastes*

PROBABLY EXTIRPATED STREAM, LAKE

Preserved specimens of this subspecies of Longear Sunfish along the south shore and tributaries of Lake Erie indicate that it was present in the Cleveland area. Probably it was numerous so long as aquatic vegetation was profuse.

Figure 31: Distribution of Bluegill, Green and Orangespotted Sunfishes.



The few records since 1900 suggest that it decreased in abundance in the area relatively early. There are three collections from the Cuyahoga River prior to 1926 but none from the study area since.

Apparently the Longear Sunfish has been extirpated from the Cleveland Metropolitan area as no specimens were collected during the survey.

(References; 119, 147, 150, 163)

86. REDEAR SUNFISH, Lepomis microlophus

LOCALLY COMMON — ARTIFICIAL LAKES

This recently introduced species has been recorded from a tributary in the upper Rocky River where it had been introduced into a pond, from which some subsequently escaped. In 1939, 142 adult Redears were liberated in Pippen Lake in the Cuyahoga drainage. Since 1944, their young have been trapped and shipped throughout Ohio for stocking purposes.

No Redear Sunfish were collected in the streams or Lake Erie during this survey. Stocked populations exist in impoundments of the river drainages, especially in the upper Cuyahoga area. This species has never been reported from Lake Erie.

(References; 147, 150)

87. PUMPKINSEED SUNFISH, Lepomis gibbosus

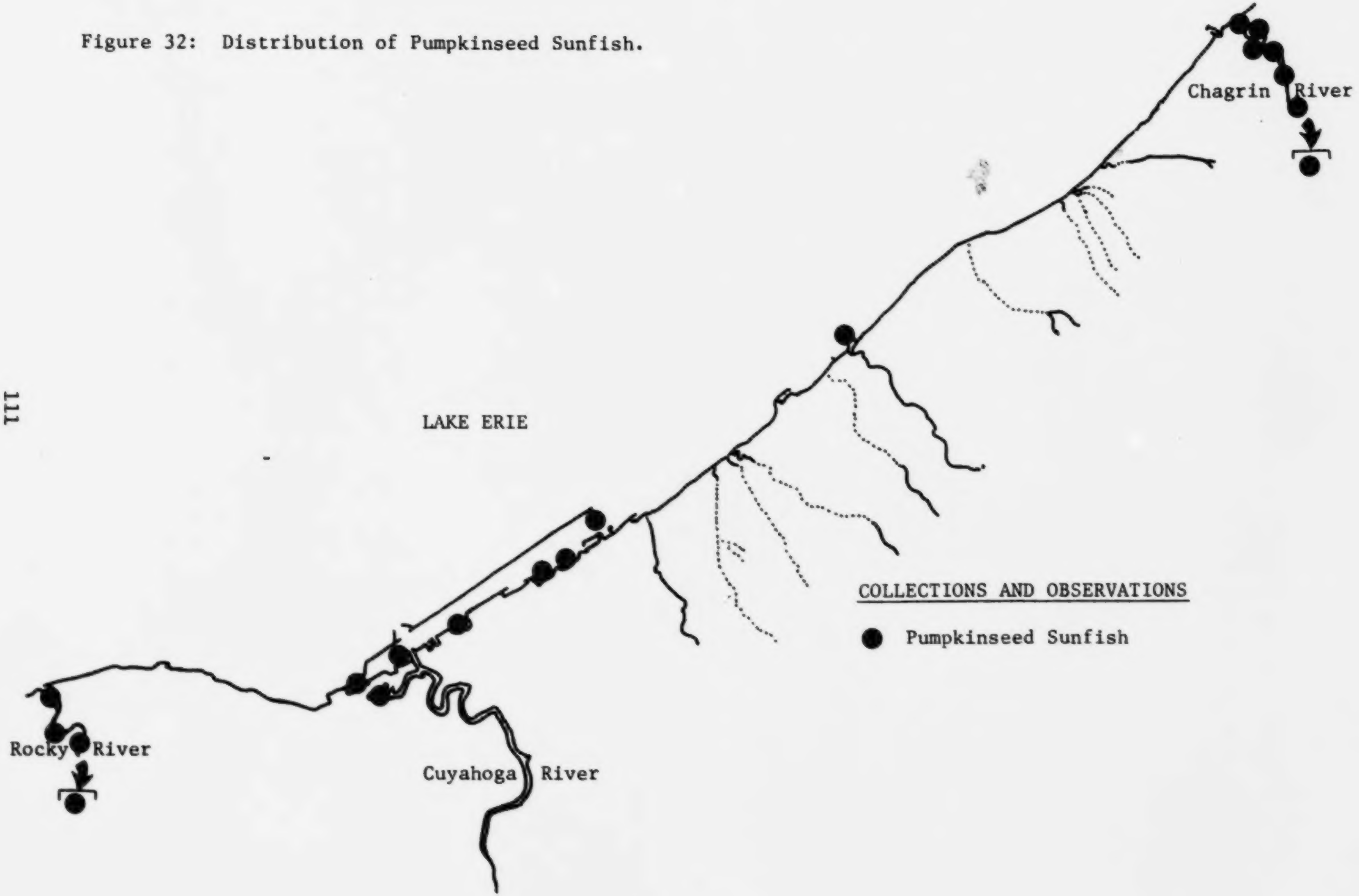
ABUNDANT — UBIQUITOUS

Preserved specimens, taken along the south shore of Lake Erie from Lucas to Ashtabula counties and numerous literature references, indicate that it was well distributed and abundant throughout this area prior to 1900. It occurred in both the streams and Lake Erie and was of some commercial importance (147).

This Sunfish has continued to be present in the tributaries and shorewaters of the Lake in the Cleveland area. There is evidence that it has continued to decrease in abundance with the continued increase in turbidity and decrease in the amount of aquatic vegetation.

The Pumpkinseed continues to be the most abundant and widely distributed sunfish species in the Cleveland area. Contrary to the reports of Havens and Emerson (135, 136), we find that it was far more numerous than the Bluegill, especially in the Chagrin River drainage. It was the sunfish species most frequently collected in Lake Erie, and was common in the Cleveland Harbor where it reproduces with some success. The Pumpkinseed Sunfish is abundant in the upper Cuyahoga and Chagrin rivers, common in the Rocky River and present in limited numbers in

Figure 32: Distribution of Pumpkinseed Sunfish.



the middle and lower portions of the Cuyahoga where the Green Sunfish surpasses it in abundance.

(References; 88, 115, 119, 124, 136, 147, 150, 163)

88. SAUGER, Stizostedion canadense

PROBABLY EXTIRPATED LAKE

Despite the confusion of the Sauger with the Walleye, there is no doubt that before 1900 it was a valuable food species of considerable commercial importance.

Between 1900 and 1945 the population throughout Lake Erie continued to be large, and in 1917, 102,410 pounds were brought into Cuyahoga County ports. Thereafter, remarkably constant decreases in abundance occurred and by 1970, the species was considered to be nearly extirpated throughout Lake Erie.

Presently, this species should be considered extirpated in the Cleveland area and, as suggested by Rieger (131), this decline was probably due to the environmental deterioration of the rivers and near shore waters. Evidence indicates that very probably, in the Cleveland area, the Sauger was dependent on the nearshore (1-3 miles) for spawning. After 1940, the deterioration of this area probably contributed to their extirpation.

(References; 40, 69, 119, 131, 147, 150)

89A. WALLEYE, Stizostedion v. vitreum

RARE LAKE

Kirtland (84) mentioned that "Lake Erie seems to be its favorite residence." Unfortunately, at this time, the Walleye and Blue Pike were not considered to be distinct. It is impossible to definitely state the relative abundance of each. Even though official records are sparce, there is little doubt that the Walleye was immensely abundant in the waters of Lake Erie prior to 1900. Records indicate that over 14 million pounds of Walleye were taken commercially in 1889, and over 12 million pounds in 1893 (118).

A drastic decline in numbers occurred in the late 1800's. By 1900 less than 2 million pounds were taken. Since the commercial catch in 1955 was 6 million pounds, it is apparent that the population never recovered to half of its original size. The major cause of this early decline was obviously construction of dams, which effectively blocked the upstream spawning runs of this highly migratory species.

Figure 33: Distribution of Walleye.

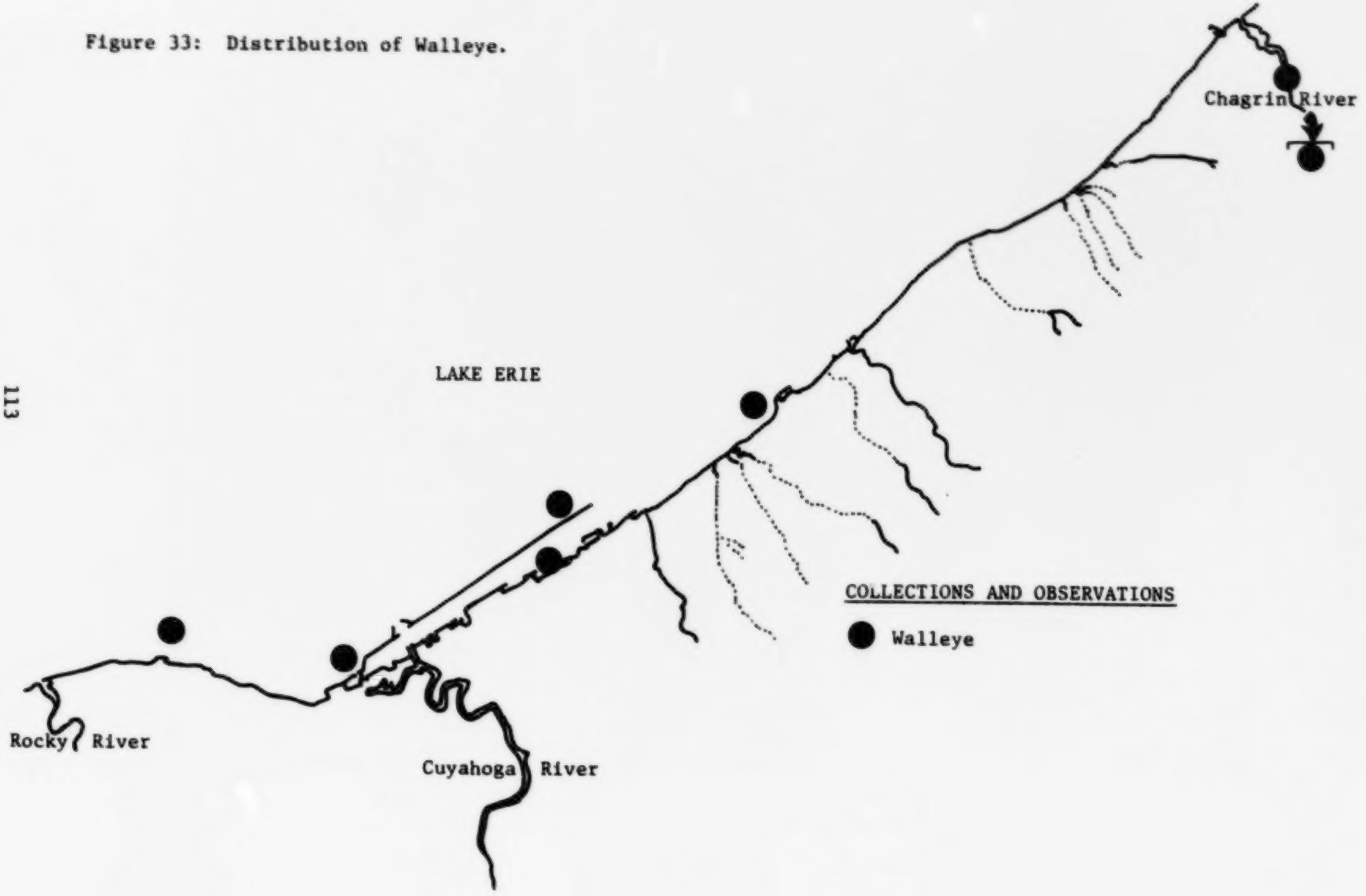


Figure 34: A Large Walleye Collected in the Cleveland Harbor in 1971. Walleye such as this one were once extremely abundant. In 1850 a person could catch more than 50 per day but in 1973 only occasional specimens were reported per year.

Since 1900, spawning was primarily in the Lake Erie island region and, to a lesser extent, in the lower rivers and shorelines of Lake Erie. The population apparently recovered slowly between 1900-1955 and then suffered another serious and sudden decline. In 1970, the total Lake Erie commercial catch was less than one million pounds. The species has not recovered from this recent decline in the Central Basin, although some recent increase, (possibly a temporary one), has been noted in the Western Basin. (Fig. 34.)

At present, the combined effects of stream obstruction, both chemical and physical, and deterioration of the rivers and near-shore areas have nearly eliminated the successful reproduction of this species in the study area. Only occasional specimens of adults are taken and the collections of a few yearlings in the lower Chagrin River suggest that a small population might be spawning in or near the stream. On the whole, this species should be considered rare in this area, having little or no reproductive success.

(References; 37, 55, 62, 64, 69, 74, 84, 111, 118, 119, 147, 150, 161)

89B. BLUE PIKE, *Stizostedion vitreum glaucum*

PROBABLY EXTIRPATED LAKE

The relative abundance of the Walleye compared with its subspecies, the Blue Pike was unknown prior to 1900. It is assumed that the Blue Pike was very abundant in the area because of proximity to the center of Blue Pike abundance in the deeper waters of Lake Erie.

After 1900, with the loss of Sturgeon, Muskellunge, Pike and Blackbass, it became increasingly important to the fisheries and was highly prized as a food fish. In 1922, for example, 1,126,158 pounds were brought into Cuyahoga County ports. After 1955, the population in Lake Erie collapsed and by 1967, the species had become commercially extirpated (37, 147, 150).

This once abundant and economically important species is presently considered by many to be extinct. It was restricted primarily to Lake Erie, the only other known populations of Blue Pike occurring in limited areas of Lakes Ontario, Huron and Winnepeg. Apparently, these other populations have undergone similar declines and the entire subspecies may well be extinct. No specimens were reported or collected during this survey.

(References; 37, 144, 147, 150)

90. YELLOW PERCH, *Perca flavescens*

ABUNDANT UBIQUITOUS

Before 1900, the Yellow Perch was widely distributed and abundant throughout Lake Erie, and was considered a "trash" species, because at that time the more desirable Whitefish, Ciscoes and other prized food fishes were abundant. At this time, Klippart (111) stated that, its "...flesh is soft, rather coarse, and insipid; at best, it is nothing more than a third-rate panfish.", and "The writers opinion is that perch make better glue than food." During this period, Sterling wrote that

> "...perch were a most worthless animal...you can have all you want [from fish dealers] for the trouble of carrying them away. I once saw three tons sold for manure...for as many dollars."

After 1900, and until 1950, the species was considered largely of secondary importance. In 1917, only 33,701 pounds were brought into Cuyahoga County ports even though they were obviously abundant. With the decrease of other food fishes after 1955, especially the Blue Pike and Walleye, the Perch became of major importance to the commercial and sport fisheries.

Recently, the species appears to be declining in numbers although it is the most important sport and commercial species in Lake Erie. In the Cleveland area it was the most abundant food species. It was currently reproducing in the Cleveland area, as evidenced by the collections of eggs and all age classes during the survey. Schools of Perch occasionally enter the lower rivers as adults, and young-of-the-year were commonly collected in the lower Chagrin River and elsewhere. Yellow Perch are currently abundant in all areas of the Cleveland Shoreline including the Cleveland Harbor, and reports of specimens taken from industrial water intakes indicate that they occasionally ascend the lower Cuyahoga River from Lake Erie. Additional specimens have been taken in the upper Chagrin and Cuyahoga rivers and may be the result of stocking in reservoirs.

(References; 37, 40, 64, 73, 83, 111, 119, 124, 147, 150, 163)

91. BLACKSIDE DARTER, *Percina maculata*

RARE STREAM

Although little is known of the abundance of this darter prior to 1900, there is no reason to doubt that it was present and perhaps locally numerous in the area.

Since 1900, the species has been found throughout the Rocky River drainage and was present in lesser numbers in the Cuyahoga and Chagrin rivers.

During the current survey, we were unable to obtain specimens from the Rocky River. A few individuals were collected from several localities in the middle portions of the Chagrin River. In addition, Orr and Rhodes (124) reported having collected two specimens in the upper Cuyahoga River. The species must now be considered locally uncommon and rare in overall abundance. This darter occasionally strays into the waters of Lake Erie (150).

(References; 119, 124, 147, 150, 163)

92. CHANNEL DARTER, *Percina copelandi*

PROBABLY EXTIRPATED LAKE

No specimens of this primarily lake species appear to have been preserved, but there is reason to believe that it was formerly numerous on the clean, sandy shores of the Cleveland area.

Between 1924 and 1950, specimens were taken at the mouth of the Rocky and Chagrin rivers. It decreased markedly in abundance after 1950 and no specimens have been reported from the study area since.

None was collected during our survey, and the species was assumed to be extirpated in the study area, probably because of the destruction of its habitat along the Lake Erie shoreline.

(References; 147, 150)

93A. OHIO LOGPERCH DARTER, *Percina caprodes caprodes*

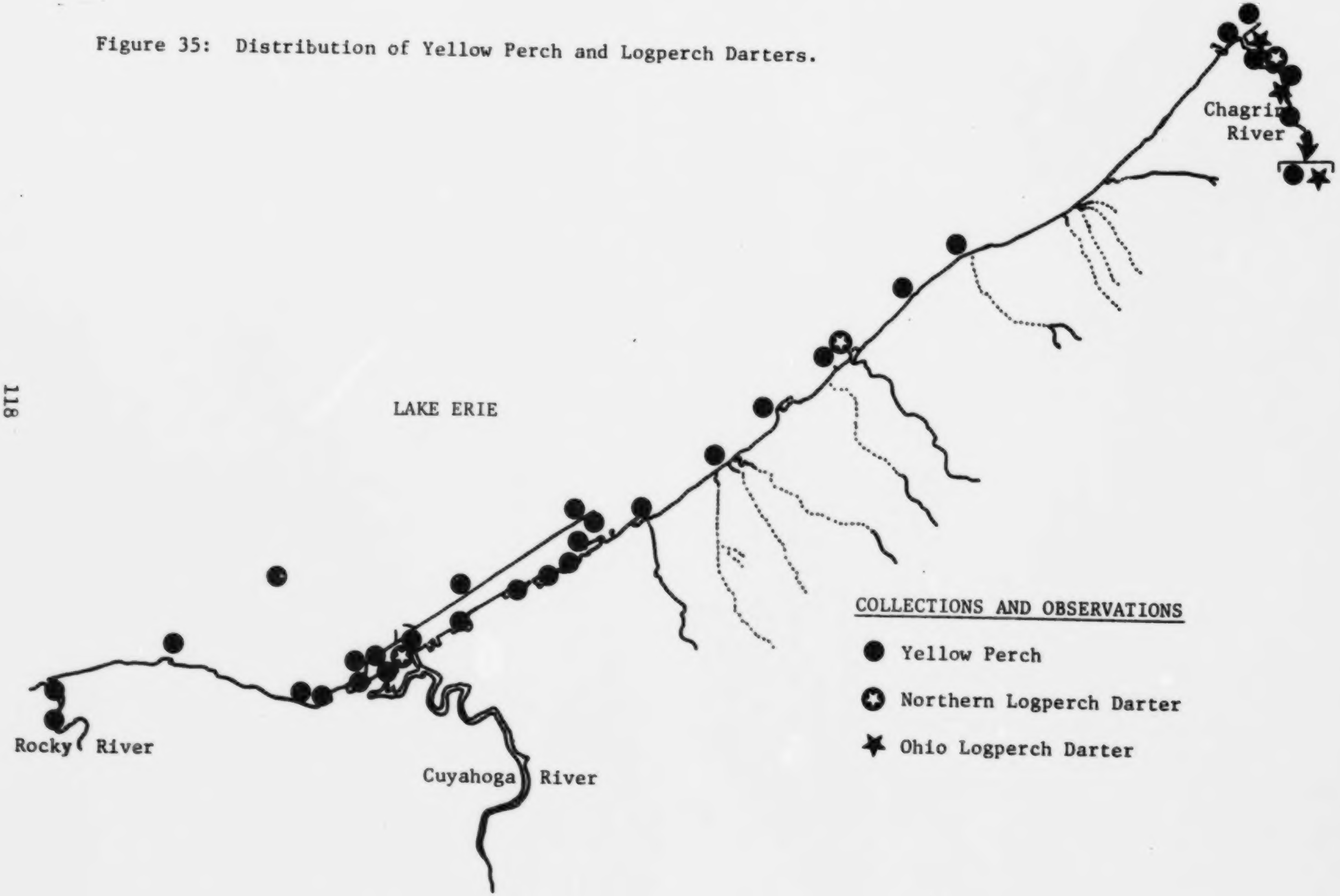
RARE STREAM

After reviewing the literature, Osburn (125) concluded that this species was widely distributed in Lake Erie and its tributaries before 1900. At that time, two subspecies of *P. caprodes* were not recognized, and it is assumed that both were included in his discussion.

Prior to this survey, the Ohio Logperch was recorded only in the Cuyahoga River drainage. It is intolerant of pollution and siltation and apparently has declined greatly in abundance.

In Ohio, this subspecies is primarily restricted to streams, although small populations occasionally persist in impoundments. During this study, one specimen was taken in the upper Cuyahoga River. An additional

Figure 35: Distribution of Yellow Perch and Logperch Darters.



Logperch specimen was collected in the lower Chagrin River and was identified as an intergrade between the Ohio and Northern Logperch. This would indicate the presence of a limited P. c. caprodes population somewhere in the Chagrin.

(References; 119, 124, 125, 147, 150, 163)

93B. NORTHERN LOGPERCH DARTER, Percina caprodes semifasciata

RARE LAKE

As has been previously stated, confusion between the two subspecies of Logperch Darters makes it difficult to determine their exact abundance before 1900. Apparently, the Northern Logperch was common along the clean beaches of the study area.

Between 1900 and 1950, several specimens were taken on beaches near Cleveland, but the population was declining along the shoreline (147).

A severe decline in numbers has occurred since 1950. Only three adults were taken in Lake Erie during this survey. In the Cleveland Harbor, the species is reproducing and small numbers of fry were collected during 1973-1974.

(References; 119, 125, 147, 150, 163)

94. EASTERN SAND DARTER, Ammocrypta pellucida

PROBABLY EXTIRPATED STREAM

From literature references and many preserved specimens we conclude that this sand-inhabiting species was present in the area prior to 1900 and probably was very numerous.

After 1900 it began to show a marked decrease throughout inland Ohio and Lake Erie. After 1960, none have been recorded from Lake Erie.

In spite of an intensive effort to collect this species, none was taken in the study area during this survey, although five specimens were collected in the adjacent Grand River.

(References; 119, 134, 147, 150)

95A. CENTRAL JOHNNY DARTER, Etheostoma nigrum nigrum

ABUNDANT STREAM

Prior to 1900, failure to differentiate between the Central Johnny and Scaly Johnny Darters made it impossible to ascertain the relative abundance of each. Members of the Johnny Darter complex could be found throughout all the tributaries and along the shores of Lake Erie in this vicinity. Typical examples of the Central Johnny Darter and intergrades with the Scaly Johnny have been preserved. They are known to have inhabited all of the streams and the lake shore in the study area. Central Johnny Darters were probably numerous in all streams and tributaries.

Since 1900, innumerable specimens have been taken from streams throughout the study area.

During the survey, this subspecies was numerous in all of the area streams, partly because of its tolerance to siltation and many types of pollutants. However, it was not collected in the lower Cuyahoga River where the pollution level was apparently intolerable. This darter is abundant throughout the Chagrin and upper Cuyahoga and Rocky drainages, whereas it was only moderately numerous in the other streams.

(References; 115, 119, 124, 125, 136, 147, 150, 163)

95B. SCALY JOHNNY DARTER, *Etheostoma nigrum eulepis*

RARE LAKE

The Scaly Johnny Darter, essentially a Lake Erie species in Ohio, was not recognized until 1935 (147). As was previously stated, there are no accurate records documenting its early abundance.

After 1935, and probably long before, this subspecies was rapidly declining in numbers.

This decline has resulted in the near extirpation of the Scaly Johnny Darters from the study area. Only a single individual was collected during the study, this from the mouth of the Chagrin River. There is an intergrading population in the lower Chagrin, and six intergrades were collected in the lowermost mile of the Chagrin.

(References; 119, 125, 147, 150)

96A. "ALLEGHENY" GREENSIDE DARTER, *Etheostoma b. blennioides*

UNCOMMON STREAM

There is reason to believe that the Greenside Darter, as a species, was present and perhaps numerous in the tributaries of this area and adjacent sections of Lake Erie before 1900.

Since 1900, it has been particularly numerous in the upper sections of the Rocky River and the upper half of the Cuyahoga River. Increased siltation of the streams and the elimination of suitable habitat has resulted in a gradual decrease in abundance in the study area.

Specimens were taken during this survey only from the Rocky and Chagrin Rivers, but it should occur in the upper Cuyahoga River as well.

(References; 121, 130, 147, 150, 163)

96B. "OZARK" GREENSIDE DARTER, *Etheostoma b. pholidotum*

RARE LAKE

In 1968, Miller (121) described this subspecies from the Ozarks. In Ohio it inhabits Lake Erie, in more or less typical form, and in tributary streams especially in the lower poritons. In the study area, we assume, that as elsewhere in Lake Erie (150), it was formerly common in the shallows along the shore line, intergrading in the lower sections of the tributaries with the "Allegheny" Greenside. At present this form is nearing extirpation from Lake Erie. None was taken from the beaches of the study area. A single specimen , captured in the Chagrin River near its mouth, was an intergrade with the "Allegheny".

(References; 121)

97. IOWA DARTER, *Etheostoma exile*

SCIENTIFICALLY EXTIRPATED STREAM

No specimens of the Iowa Darter were reported prior to 1900. There is no reason, however, to doubt their presence in the area, especially in pothole lakes and streams having much aquatic vegetation and a rich organic bottom.

Between 1900 and 1950, the species was taken in several localities in the upper Cuyahoga and Chagrin rivers, after which it appears to have been extirpated from most of these localities.

Despite intensive seining, none was taken during this survey and it may be considered to be scientifically extirpated in the area.

(References; 147, 150)

98. RAINBOW DARTER, Etheostoma caeruleum

ABUNDANT STREAM

Literature records before 1900 are unreliable in most sections of Ohio because of confusion with the superficially similar species, the Orangethroat Darter. Because the Orangethroat does not occur in this area and since sufficient material is preserved from Cuyahoga, Lake, Geauga, Portage, Summit and Medina Counties, we have been provided with sufficient evidence of its former, widespread distribution (147).

Since 1900, it has been numerous throughout the tributaries, especially east of the Allegheny Front Escarpment.

Presently in the study area the Rainbow Darter appears to be most common in the upper Chagrin River, although smaller populations exist in the upper Cuyahoga and Rocky river drainages.

(References; 115, 119, 124, 136, 147, 150, 163)

99. BARRED FANTAIL DARTER, Etheostoma f. flabellare

COMMON STREAM

Published records and preserved specimens indicate that before 1900 this species was abundant and of general distribution in the Lake Erie drainage, including this area.

Since 1900, it was numerous in all tributaries, especially in those portions containing sluggish riffles and in pools having a swift current.

At present a decline in universal abundance is evident and the species is primarily restricted to small headwater tributaries of the rivers in the study area which have not yet been subjected to the effects of pollutants.

(References; 124, 125, 136, 147, 150, 163)

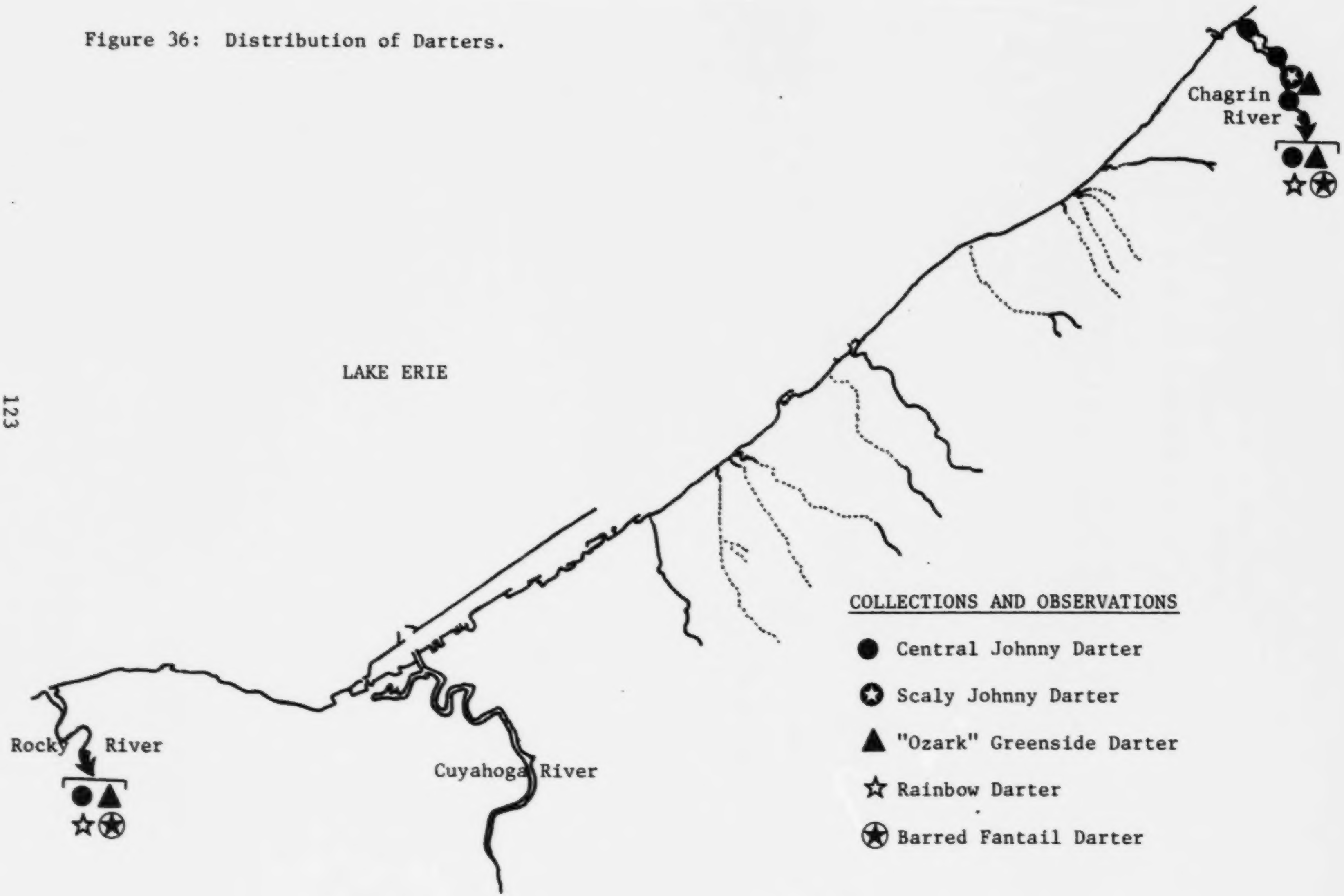
100. FRESHWATER DRUM, Aplodinotus grunniens

ABUNDANT LAKE

Kirtland (80) stated that Lake Erie "...abounds with this species."

Since 1900 the Drum has been an abundant inhabitant of Lake Erie; 95,019 lbs. were brought into Cuyahoga County ports in 1922. If there has been a change in numerical abundance, it is towards greater numbers. Hartman (37) in giving possible causes for this increase states,

Figure 36: Distribution of Darters.



> "The eggs are semi-buoyant and float at or near the water surface, and thus avoid potentially deleterious conditions on the lake bottom. Newly hatched larvae also tend to remain near the surface."

This possible increase in the population is not to be considered favorable. Hartmen continues,

> "...this warm water species has virtually no commercial market value and little appeal to sports fishermen in Lake Erie."

Although this species occurs in great numbers in the Cleveland area of Lake Erie, it is not as numerous as the Yellow Perch or Gizzard Shad. Furthermore, during the cooler months of the year, it retreats to the deeper portion of the Lake and becomes strikingly less abundant in the near-shore waters of the study area. The Drum occasionally migrates upstream and was taken as far upstream in the Chagrin River as the Willoughby Dam. Collections of many year classes, including fry, indicate that it successfully reproduces in the area.

(References; 37, 66, 80, 109, 119, 144, 147, 150)

101A. CENTRAL MOTTLED SCULPIN, Cottus b. bairdi

RARE STREAM

Although no locality records exist prior to 1900 (147), this subspecies undoubtedly occurred in the small tributaries of the area. Early conditions were more favorable than at present.

After 1900, sculpins were taken in several localities in the upper half of the Cuyahoga and Chagrin rivers.

No collections of this species were made during this study. Although it was not collected, it cannot be assumed to be extirpated from the area, since many tiny tributaries were not sampled. We believe that limited populations exist in the headwaters of the Chagrin and Cuyahoga rivers. Obviously, Central Mottled Sculpins have become restricted in their range and greatly reduced in numerical abundance.

(References; 119, 147, 150, 163)

101B. NORTHERN MOTTLED SCULPIN, Cottus bairdi kumlieni

RARE LAKE

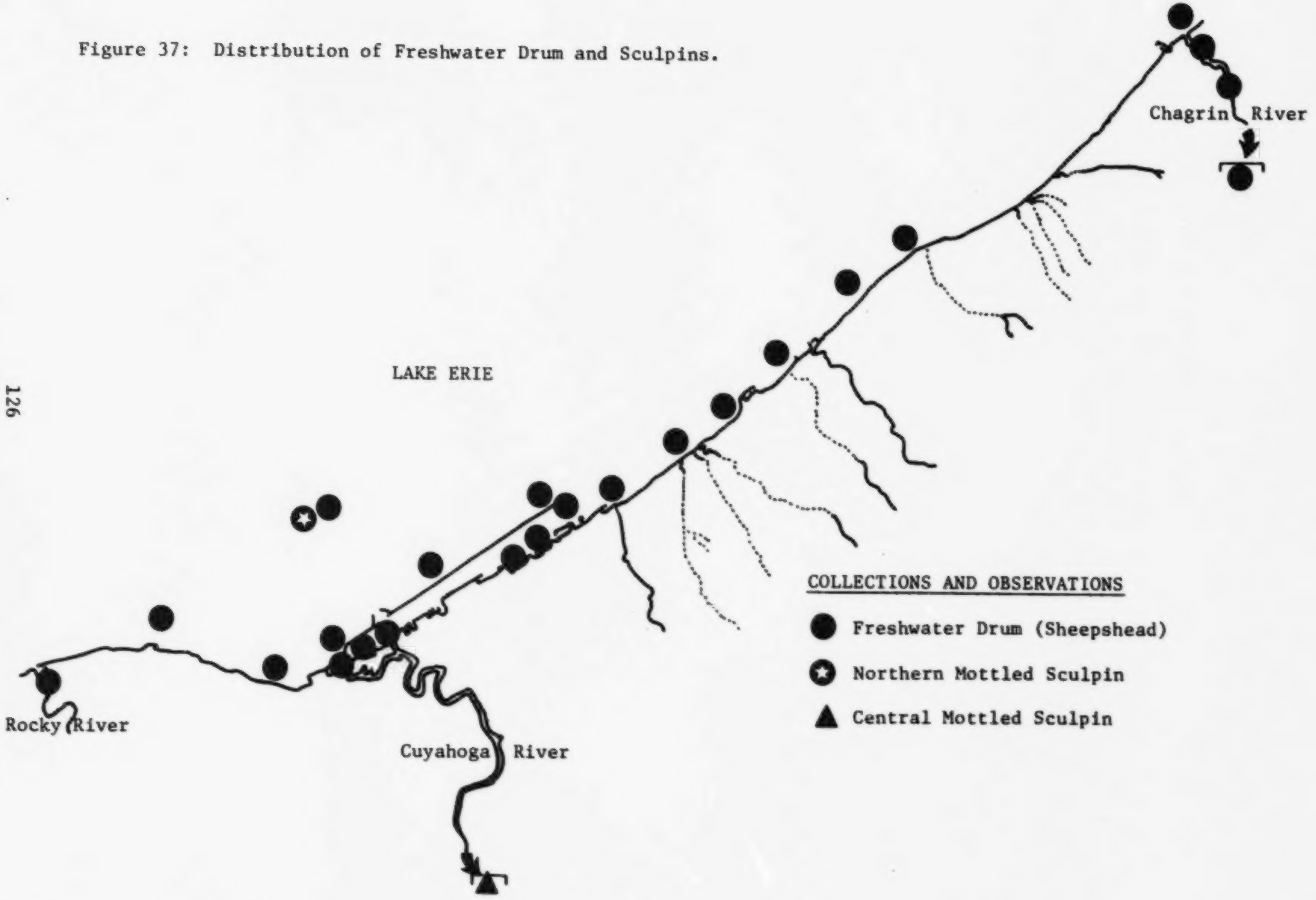
Another sculpin subspecies had been taken east of the study area near the Ohio-Pennsylvania border. This subspecies inhabits Lake Erie, and was not reported from the Eastern or Central Basins.

In 1974, a specimen of a Northern Mottled Sculpin was given to us by Mr. David Kananen, of the City of Cleveland. The specimen had been taken from the water intake screens. Apparently it was pulled into the intake a few miles offshore. This specimen represents the first record of the subspecies in the Central Basin.

In other areas, the Northern Mottled Sculpin was captured only in shallow waters during the colder portions of the year, usually at the time of ice formation (147). It is probable that a small population inhabits the Cleveland area beaches during the winter months, retreating to deeper waters at other times of the year.

(References; 147, 150)

Figure 37: Distribution of Freshwater Drum and Sculpins.


Chagrin River
LAKE ERIE
Rocky River
Cuyahoga River
COLLECTIONS AND OBSERVATIONS
● Freshwater Drum (Sheepshead)
✪ Northern Mottled Sculpin
▲ Central Mottled Sculpin

Nursery Zones Within the Study Area

No attempt was made to intensively survey the study area for nursery zones but certain observations should be included in this report. It should be understood that more work in this area is necessary and should be conducted in the future .

Fish fry and young-of-the-year were routinely collected during seining operations throughout the survey and occasionally were taken in trawls or gill nets. Three principal nursery areas occur along the Lake Erie shoreline in the study area. In order of increasing importance (in terms of numbers of individuals) they are;the mouth, lower one mile and adjacent shoreline of the Rocky River; the mouth and adjacent shoreline of the Chagrin River; and the Cleveland Harbor and adjacent marinas. The area which produces the most diverse fauna is the Chagrin River nursery; a slightly less diverse fauna is in the Rocky River nursery area; and in the Cleveland Harbor, most of the nursery is dominated by a few species.

The following tables (3-5) indicate those species which are collected as fry or young-of-the-year in the three principal nursery areas. As it is not unusual to collect a large number of young fishes when seining due to the collection of an entire school, the number of individuals becomes somewhat irrelevent. The abundance of each species has been depicted as a relative term, Abundant, Common or Rare. It was often the occurrence that we collected several thousand fry or young-of-the-year during a single seining sample, all but a few specimens were invariably released.

Spawning Areas

It is obvious that most smaller, non-migratory species of fishes are reproducing within the study area. The success of these species is individually expressed in their distributions and abundances which have already been discussed. Certain species have been observed spawning within the Cleveland Harbor and its adjacent marinas. Some have been documented as spawning in the lower Cuyahoga River. As it is generally assumed that these two areas do not support the reproduction of fishes, we feel that these observations should be discussed even though a study of spawning areas was not actively pursued. It is probable that the list of fry and young-of-the-year are similar to a list that could be constructed of the spawning areas, should such a study have been done.

During 1972-74, the Goldfish, Pumpkinseed Sunfish,Largemouth Blackbass and Yellow Perch were documented as spawning within the Cleveland

Table 3 : Species of Fishes Collected as Fry or Young-of-the-Year in the Cleveland Harbor, 1972-1974.

Species	Abundance
Alewife	Abundant
Eastern Gizzard Shad	Abundant
Rainbow Smelt	Abundant
Eastern Quillback	Rare
Common White Sucker	Uncommon
Carp	Common
Goldfish	Common
Golden Shiner	Abundant
Longnose Dace	Rare
Common Emerald Shiner	Abundant
Spottail Shiner	Uncommon
Fathead Minnow	Rare
Bluntnose Minnow	Common
Trout-perch	Rare
Brook Silverside	Rare
White Bass	Uncommon
Rockbass	Uncommon
Largemouth Blackbass	Rare
Green Sunfish	Uncommon
Bluegill Sunfish	Common
Pumpkinseed Sunfish	Abundant
Yellow Perch	Common
Northern Logperch Darter	Rare
White Crappie	Uncommon

Table 4 : Species of Fishes Collected as Fry or Young-of-the-Year in the Rocky River Near Lake Erie, 1972-1974

Species	Species
Alewife	Eastern Gizzard Shad
Central Quillback	Golden Redhorse
Common White Sucker	Carp
Goldfish	Goldenshiner
Common Emerald Shiner	Spottail Shiner
Spotfin Shiner	Northeastern Sand Shiner
Silverjaw Minnow	Bluntnose Minnow
Brown Bullhead	Brook Stickleback
White Bass	White Crappie
Rockbass	Largemouth Blackbass
Smallmouth Blackbass	Green Sunfish
Bluegill Sunfish	Pumpkinseed Sunfish
Yellow Perch	Freshwater Drum (Sheepshead)

Table 5 : Species of Fishes Collected as Fry or Young-of-the-Year in the Lower Chagrin River and Adjacent Areas of Shoreline, 1972-1974.

Species	Species
Longnose Gar	Alewife
Eastern Gizzard Shad	Rainbow Smelt
Grass Pickerel	Carp
Goldfish	Golden Shiner
Longnose Dace	Creek Chub
Common Emerald Shiner	Spottail Shiner
Spotfin Shiner	Northeastern Sand Shiner
Silverjaw Minnow	Bluntnose Minnow
Channel Catfish	Brown Bullhead
Black Bullhead	Brook Silverside
White Bass	White Crappie
Black Crappie	Rockbass
Smallmouth Blackbass	Largemouth Blackbass
Green Sunfish	Pumpkinseed Sunfish
Bluegill Sunfish	Orangespotted Sunfish
Eastern Quillback	Central Quillback
Golden Redhorse	Black Redhorse
Common White Sucker	Yellow Perch
Scaly Johnny Darter	Freshwater Drum (Sheepshead)

Harbor. Goldfish were observed to be depositing eggs on the undersides of boats in the marinas and on the pilings within the harbor. Yellow Perch spawned within the harbor utilizing debris to attach the eggs. Such items as newspapers, wire, tree branches etc. were commonly used. At one point, the Yellow Perch deposited large quantities of eggs on the anchor lines and mesh of our gill nets. Pumpkinseed Sunfish and Largemouth Blackbass were frequently observed tending nests which contained eggs. Green Sunfish were observed nesting in the old river channel of the Cuyahoga by Mr. Larry McGeehan and Mr. Dave Kananen of the City of Cleveland. The Centrarchid nests were usually located on flat surfaces of objects such as the breakwall rock, boards or submerged marina steps. The success of these species was documented by the collection of fry, but the success is limited in most cases. As has been indicated in Table Five, many other species of fry were collected within the Cleveland Harbor, and it is probably that all of these are reproducing with limited success.

Other areas also serve as spawning and nursery areas, but these were not actively examined. Of interest in this discussion is the lower ten miles of the Cuyahoga River. We have previously stated that in this area the Goldfish and Green Sunfish were observed spawning in 1974. We have observed that above the Southerly Sewage Treatment Plant, large quantities of young fishes may be collected. One such collection (at Granger Road) produced the following fry and young-of-the-year, (estimated numbers):

Creek Chub	50
Goldfish	25
Brook Stickleback	5
Common White Sucker	10
Stoneroller Minnow	15
Green Sunfish	1

Below the Sewage Plant, and especially as one approaches the Lake, the condition of the river worsens. Within the lower five miles only the Goldfish, Emerald Shiner and Green Sunfish were collected as Young-of-the-Year or fry. Even though these species are present in the lower few miles of river, one can hardly consider the lower Cuyahoga as a spawning or nursery zone.

The Yellow Perch in the Cleveland Area

The Yellow Perch is the most abundant commercial and sport fish species in the Cleveland Area. Its population remains rather high, although not as high as in past years. In spring, the species is abundant enough to collect several hundred specimens from a 1000 ft. experimental gill net in 24 hours. It is the most sought after sport species and contributes greatly to the remaining commercial fishery in the Central Basin of Lake Erie. Because of its economic importance, a study was made of its growth rate and population structure, to determine the possible effects of the Cleveland water quality on the species. The study was conducted on specimens collected in the nearshore waters near the Cleveland Harbor.

In examining the possible effects of the Cleveland shoreline on the Yellow Perch, two methods were utilized (1) the length to age relationship and (2) the length to weight relationship.

Specimens were collected in the summer of 1972. In order to standardize the age to length data, only the June and July specimens were used, whereas the length to weight relationship utilized all specimens that were collected during the year.

During the period of study, 539 Yellow Perch were aged and the length to age relationship was plotted (Fig. 38). Considering that gill nets are extremely selective (56) it is not surprising that the year classes 0+ and I+ are poorly represented in the catch. Gill net of the 1 inch size or smaller was not used in the survey. If, however, we examine the year classes II+ through V+, a pattern emerges that is very similar to that of other Lake Erie studies. The overlap in length of several age classes is considered to be normal for the Yellow Perch in the Lake. The decreasing percentage of individuals in succeeding years is also normal. In all respects, the length-age relationships seem to be compatable to that found elsewhere in Lake Erie (133).

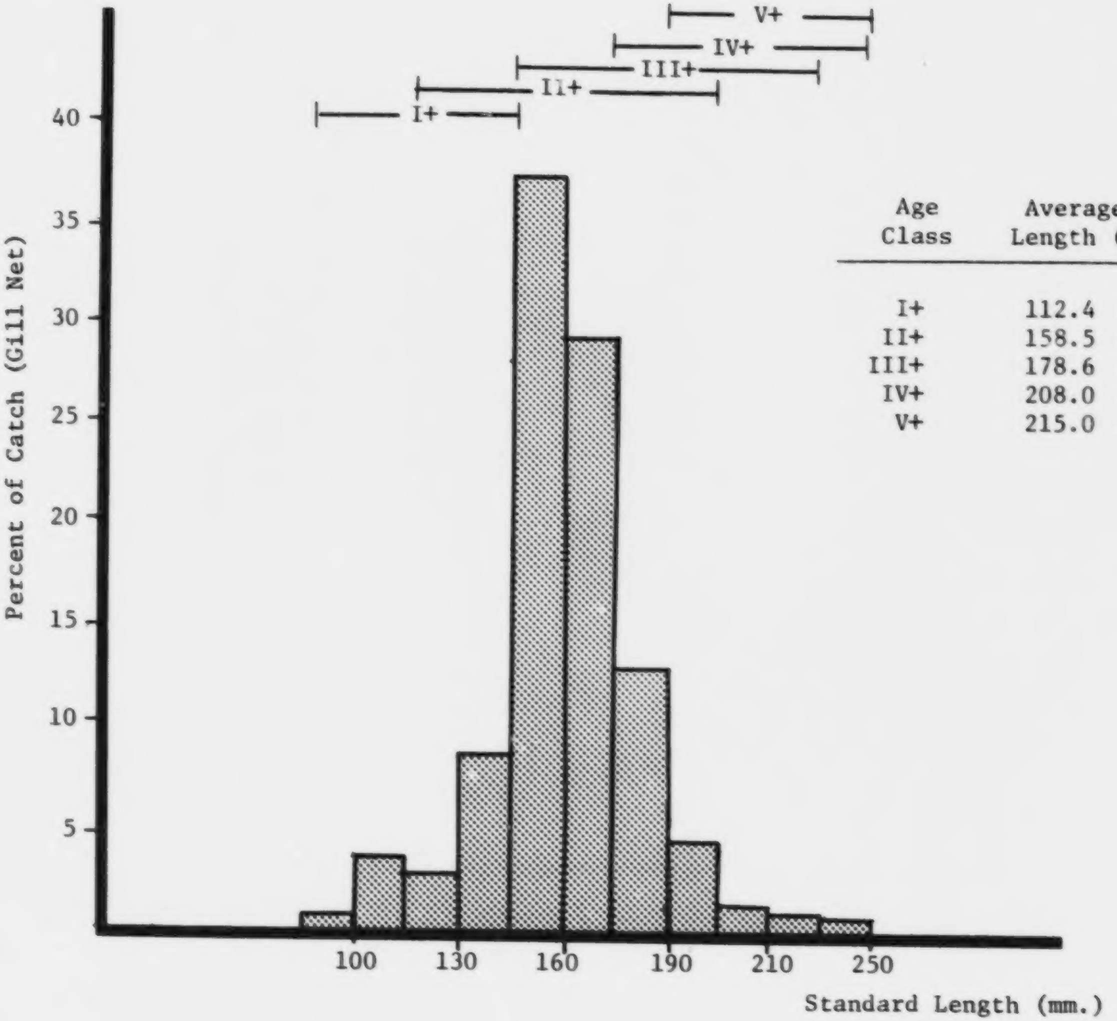
The relationship of length to weight, known as the coefficient of condition or "relative fatness", may be utilized to determine the condition of an individual fish specimen or population of a given species. A starved, stunted or diseased individual or population will be relatively lighter per mm. of length, and therefore, will have a lower coefficient of condition (K).

The K for any given species will also be dissimilar at different localities and in different years. For example, in the Western Basin of Lake Erie in 1952, the K for the Yellow Perch was 1.78-2.19 (56), while in the colder northern waters of Wisconsin the K for the same species was 1.72-1.92.

During our study, a total of 1,654 specimens of Yellow Perch were examined and the K factor calculated. As explained by Jobes (56), the K factor is influenced slightly by seasonal changes, (especially due to the increase in gonad size) and also is influenced by gill net techniques since "fatter" specimens tend to be collected more frequently. In spite of these fluctuations, the K factor of specimens from the Cleveland area consistantly shows high value, indicating that they are in good condition and are not heavily stressed due to the poor quality of the waters. The average value for all Yellow Perch examined was 2.2 (range 2.06-2.45). When the length of the Cleveland area

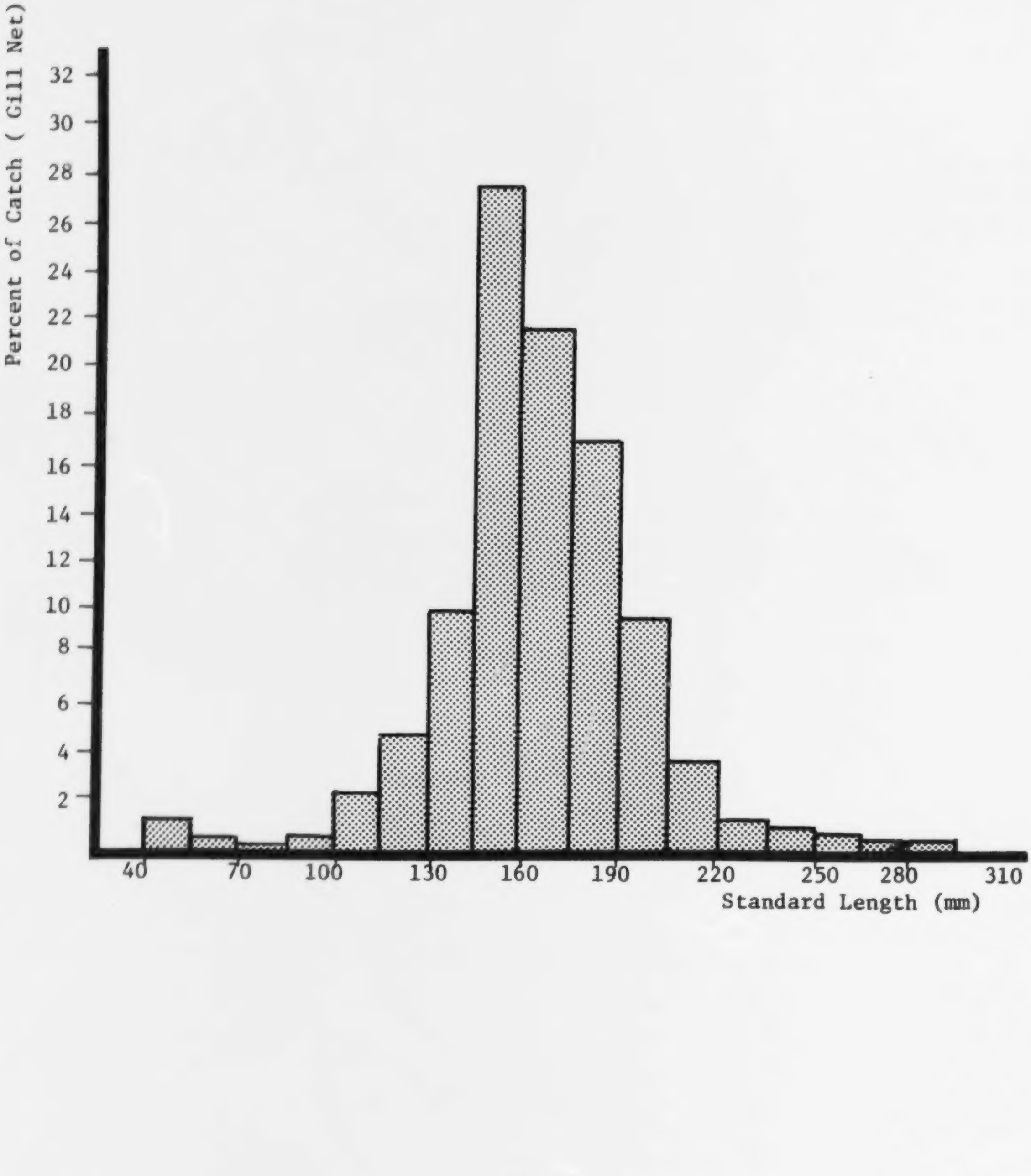
Figure 38: Length Frequency Distribution of 539 Aged Yellow Perch. (From Lake Erie near Cleveland, Ohio, 1971 - 1972).

GILL NET SURVEY



Age Class	Average Length (mm)	Percent of Catch
I+	112.4 mm.	5.0 %
II+	158.5 mm.	76.3 %
III+	178.6 mm.	16.7 %
IV+	208.0 mm.	1.1 %
V+	215.0 mm.	0.9 %

Figure 39: Length Frequency Distribution of 1,671 Yellow Perch.(From Lake Erie near Cleveland, Ohio 1971 - 1972.).



Perch is plotted against the weight, the resultant curve (Fig. 40)is very similar to that indicated by Jobes (56). It is evident that adult Yellow Perch are not severely harmed by the water quality in Cleveland, and in fact, seem to be growing well and are slightly heavier than those from the Western Basin of Lake Erie.

Even though the above discussion seems to indicate that perch are doing well in Cleveland area waters, it must be remembered that the population is considerably lower in numbers than in past years. Commercial fishermen (161) report that catches of Yellow Perch continue to decline in terms of catch per unit of effort. This decline cannot be attributed to the killing of fishes by pollutants, for major fish kills (perch) are uncommon in the area and certainly do not contribute significantly to reductions in population size. Similarly, the commercial fishing cannot be blamed, for only one vessel was engaged in fishing the area during 1972, and this vessel has recently left Cleveland to fish elsewhere in Lake Erie. Probably sports fishing presently removes more and smaller individuals than does commercial fishing, but we doubt that the combined effort of both fisheries has had much effect on the Yellow Perch population.

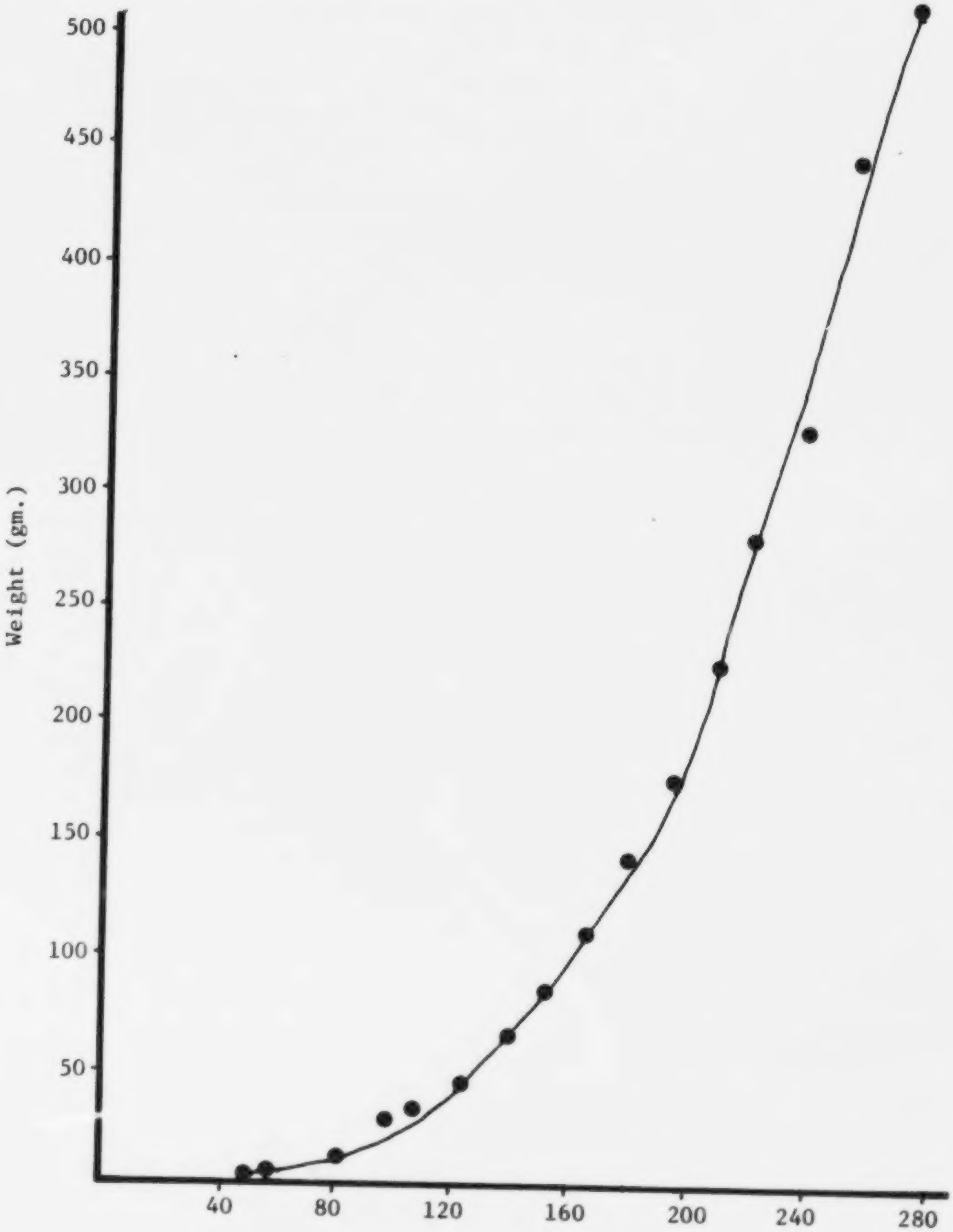
Considering that relatively few individuals are removed and that the fishes are growing well and show little apparent stress from pollutants as adults, the probability exists that a lack of reproductive success would explain the continued decline of this species. This might be attributed to the individual or combined effects of a number of factors among which several appear particularly obvious (See p. 18). It is our opinion that the poor quality of the nearshore waters in the area of Cleveland have an influence on the population of young Yellow Perch. The decline of forage species (shiners, minnows, etc.) has probably led to a lack of available food not only for the adult Perch but also for the Freshwater Drum, Aplodinotus grunniens. It is possible that Drum, Smelt, adult Perch and other species have begun to feed more heavily on young Perch in lieu of shiners. This possibility is the direct result of the degradation of the water quality along the shoreline.

The feeding behavior of Yellow Perch, Freshwater Drum and Rainbow Smelt should be thoroughly investigated in the near future.

The Commercial and Sports Fishery, Past and Present

Originally, the commercial fishery in Lake Erie near Cleveland was a viable and thriving operation. In 1922, a total of eleven vessels and 19 small craft were engaged in fishing or transporting commercial fishes and 171 persons were employed by the industry (144). Beach seining, gill netting, trap netting, trotlines and handlines were all

Figure 40: Length to Weight Relationship for Yellow Perch Population.



employed by the fishermen. During that year, 5,076,591 pounds of fish were landed in the port of Cleveland.

The commercial fishery has declined steadily. By 1955 the industry had dwindled to a few individual fishermen. By 1972, only a single vessel was engaged in the fishery and this was crewed by a single man. The catch during that year was valued at a few thousand dollars. In 1973 this last vessel was sold, and now there is no commercial fishing activity from the port of Cleveland.

The economic loss to the Cleveland area is considerable. Because of its steady decline the loss of this fishery has gone virtually unnoticed. At present, nearly all of the fresh fish sold in the city are imported, and most of these are from Canadian sources. In table 6 we have utilized information regarding the 1922 catch in Cleveland waters, and have projected this to 1973 prices, to obtain a better appraisal of the economic loss to the area. We realize that this is a rough estimate. It should be noted that 1922 was already a depressed fishery, (see history of the Fishery), and is not at all representative of the fishery possible under the 1850 ecosystem.

We have converted the value of each species to a present day value (per pound, live, wholesale),and in those cases where a species is no longer marketed because of legislation or unavailability we have converted the 1922 dollar value to 1973 value as per the US Bureau of Statistics figures.

The total dollar value of $2,739,475.00 is considered to be an approximate annual loss to the area. This figure is only the value of round fish (uncleaned) and does not include the revenue lost to associated industries such as packing, marketing or transportation. To more fully realize the loss, one should multiply this figure by approximately 2.7, the 1973 Cleveland conversion from wholesale round fish to retail fillet. The resultant dollar loss figure then becomes approximately $7,396,482, obviously a considerable loss to the Cleveland economy.

The sport fishery has declined greatly. The fishery, once attractive to anglers seeking Walleye, Blue Pike, Smallmouth Blackbass etc. (See pp. 104, 112), has now become a White Bass, Yellow Perch and Carp fishery attractive primarily to local residents. It is difficult to estimate the loss in revenue because of the deterioration of the sport fishery. Several studies have shown that the normal sports catches for some species usually exceed the commercial catch, (Ref. 25, and others), thus placing a high value on the tonnage caught. Furthermore, the economic value of associated businesses such as bait sales, fishing tackle shops, meals, lodging and gasoline are normal additional revenues associated with a sports fishery which attracts non-residents. The loss of revenue to Cleveland residents, both in real monies and in

Table 6 : Comparison of the Value of the Commercial Fishery in Cleveland based on the 1922 Catch and the 1973 Wholesale Prices for Round Fish.

Species	Landing Value (1922)	Total Pounds (1922)	Price Per Landing Pound (July,1973)	Landing Value (1973)
Burbot	$ 803.00	55,925	$ Unknown	$ 2,674.00
Carp	1,732.00	47,021	.05	2,351.00
Catfish	1,544.00	20,670	.40	8,268.00
Cisco	73,286.00	1,460,630	Unknown	244,042.00
Northern Pike	2,721.00	54,425	Unknown	9,061.00
Blue Pike	140,625.00	2,497,363	.90	2,247,627.00
Walleye	8,494.00	56,562	.75	42,422.00
Sauger	16,115.00	400,698	Unknown	53,663.00
Freshwater Drum	2,111.00	95,019	.04	3,801.00
Suckers & Redhorse	1,975.00	83,408	.03	2,503.00
White Bass	1,719.00	37,286	.27	10,067.00
Whitefishes	846.00	4,702	.55	2,586.00
Yellow Perch	14,480.00	262,882	.42	110,410.00
Totals	$ 266,451.00	5,076,591 lbs.		$ 2,739,475.00

the value of those fishes captured by anglers is obviously a considerable loss. When this is added to the estimated loss by the commercial industry, it would seem that the total is a large enough figure to be of real economic concern to the City of Cleveland.

Population Fluctuations

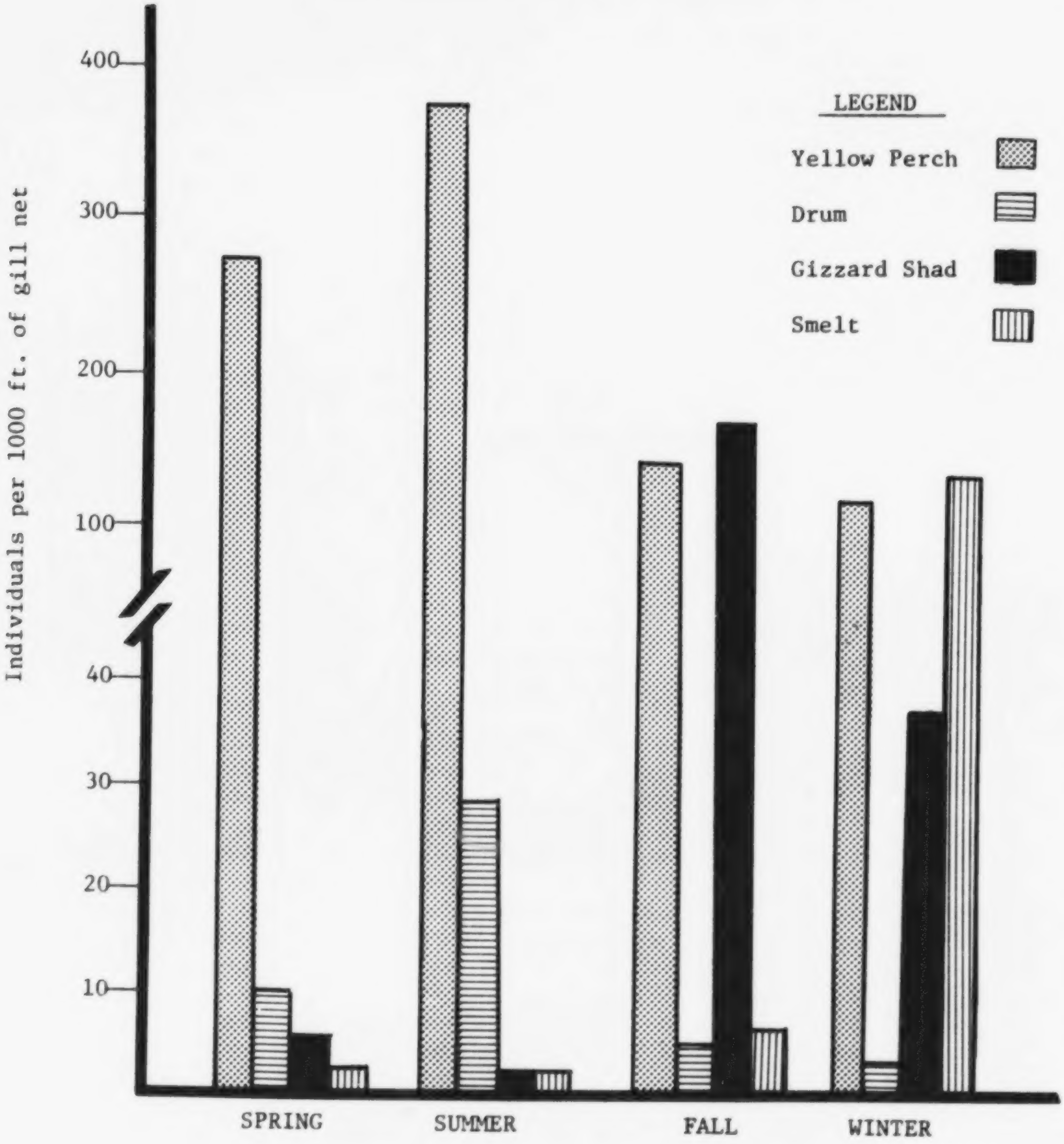
It has long been recognized that seasonal fluctuations occur in fish populations in given areas. Failure to recognize this may lead to an improper evaluation of the relative abundance of a given species. The Cleveland area is no exception. Many cold water species of Lake Erie fishes frequent the nearshore waters only during the colder months. Such species as the Burbot, Lake Trout and Cisco were rare or absent during the summer months although they were formerly present, at times abundant, in the winter. Prior to their extirpation from the Cleveland area, the Whitefish behaved in a similar manner.

Other species utilized the shallow waters primarily during spring. These entered the area to spawn and quickly retreated to the cooler, deeper portions of the Lake. This has always been the case with the present population of Trout-perches. This species was collected in large numbers during March and May, 1972, but not a specimen was taken during the following eight month sampling period. Recently, we have ascertained the exact month in which the Trout-perch migrate to the shoreline, arriving in the last week of January and first week of February; leaving soon after spawning late in May. It is obvious that unless samples are taken of the fish fauna during the early part of the year, such a species would not be observed and thus might be considered not present.

Other fluctuations in numerical abundance were noted along the Cleveland area shoreline immediately following periods of stormy weather. These fluctuations are well-known to commercial fishermen. During high winds the soft muck bottom in the vicinity of Cleveland is stirred by wave action, apparently causing such high turbidities (and perhaps low dissolved oxygen levels) that the fishes retreat to the deeper, cleaner areas approximately three to ten miles from shore. They remain offshore (apparently scattered) for approximately three days after the storm subsides. Recognizing this phenomenon early in our studies, gill nets were set only during prolonged periods of calmer weather. This tended to standardize the samples even though it reduced the number of samples obtained.

Observations of the seasonal population fluctuations of four abundant Lake Erie fish species made during the course of the study are presented in Figure 41. These data were obtained during 1972. Collections made during the month of March, April and May comprise the Spring period; June, July and August are designated Summer; September,

Figure 41 : Fluctuations in the population size of four Lake Erie Species in the Vicinity of Cleveland, Ohio.



October and November are presented as Fall; and December 1971 is combined with January and February of 1972 to indicate the Winter abundances. Although the lengths of gill nets used (See Methods) varied from time to time, the numerical abundance of the Yellow Perch, Rainbow Smelt, Eastern Gizzard Shad and Freshwater Drum was standardized by presenting the data in terms of numbers of individuals captured per 1000 feet of experimental gill net. It can be seen that although these species are present during each season, the abundance of each changes considerably. For example, the abundance of Gizzard Shad in the Fall is 100-fold greater than in Summer; and the population of Rainbow Smelt is 25 times greater in Winter than in Fall. Drum are most abundant in Summer when it is at least 5 times more numerous than in other seasons.

Such fluctuations represent the movement of large quantities of fishes both to and from the nearshore waters in the vicinity of Cleveland. It follows that to ascertain water quality of a given area, samples must be taken during each of the four seasons, in order to insure a proper evaluation of the relative abundance of fish species.

We have observed a similar phenomenon of abundance fluctuations in the lower portions of the river drainages. This is not surprising, but it is important to note that these changes often occurred on a regular basis. Migrations of both lake and stream species to and from the lower sections of rivers often changed species composition significantly. The utilization of limited samples of fishes to determine the water quality of the lower river watersheds is at best risky, and at most, probably inaccurate. As an example of this fluctuation, Table 7 illustrates a series of six collections at a single site in the lower Rocky River taken over a period of 10 months in 1972. These collections were made with similar techniques and effort, and were standardized by converting the data to fishes captured per hour of seining. As can be seen, the species composition, relative abundance and species diversity index changes significantly from collection to collection.

For example, a collection made on May 18, 1972, yielded 13 species of fishes and contained both stream and lake species. A subsequent collection made on the 27th of July, 1972, contained only four species, all considered to be permanent residents of the lower river. A further examination of these data indicates that the Spottail Shiner,predominantly a Lake Erie species, was no longer present, and, in fact, it was not until October that this species was again collected at the site. White Bass likewise had retreated from the area and again returned during the October sample period. These data may or may not indicate mass migrations of certain species into the lower rivers, but since the presence or absence of species and the number collected are factors in the calculation of the species diversity index, it can be seen that a very low index might be normal during certain periods of the year. It might be added that stream samples are normally taken during the summer, thus increasing the chances of low indices.

Table 7: Fluctuations in Fish Species Composition and Abundance in the Lower Rocky River.

Species	Collection Date 18/Jan	 27/Mar	 18/May	 27/Jul	 6/Oct	 16/Oct
Alewife	----	----	----	----	50	5
Eastern Gizzard Shad	----	2	300	----	150	20
Coho Salmon	----	1	----	----	1	----
Chinook Salmon	----	1	----	----	----	----
Central Quillback	----	2	----	----	----	8
Common White Sucker	----	1	----	----	4	----
Carp	----	5	----	----	3	1
Goldfish	----	----	----	----	1	----
Golden Shiner	----	----	10	----	----	----
Longnose Dace	----	----	----	----	1	----
Common Emerald Shiner	3	2000	2000	1	21	5
Redfin Shiner	----	----	----	----	1	----
Striped Shiner	----	4	1	----	----	----
Spottail Shiner	1	200	500	----	----	5
Spotfin Shiner	64	50	6	----	40	----
Northeastern Sand Shiner	3	1	----	----	1	25
Northern Mimic Shiner	----	2	----	----	----	----
Fathead Minnow	----	2	1	----	4	----
Bluntnose Minnow	13	30	30	----	25	2
Stoneroller Minnow	1	----	----	----	----	----
Brown Bullhead	----	1	----	----	----	----
Brook Silverside	----	----	----	----	----	1
White Bass	----	----	50	----	200	100
Northern Rockbass	----	----	----	----	----	1
N. Smallmouth Blackbass	----	----	----	2	----	----
N. Largemouth Blackbass	----	----	----	1	----	----
Bluegill Sunfish	----	----	20	1	6	10
Pumpkinseed Sunfish	----	----	2	----	----	----
Yellow Perch	----	25	1	----	----	----
Total Species	6	14	13	4	15	12
Diversity Index	1.204	0.846	1.435	1.922	2.389	2.284

The species diversity index of this single site fluctuated between .846 and 2.38 over the 10 month period, depending on which month was examined. By most standards this would translate into both a poor water quality and a rather good water quality in the same stream.

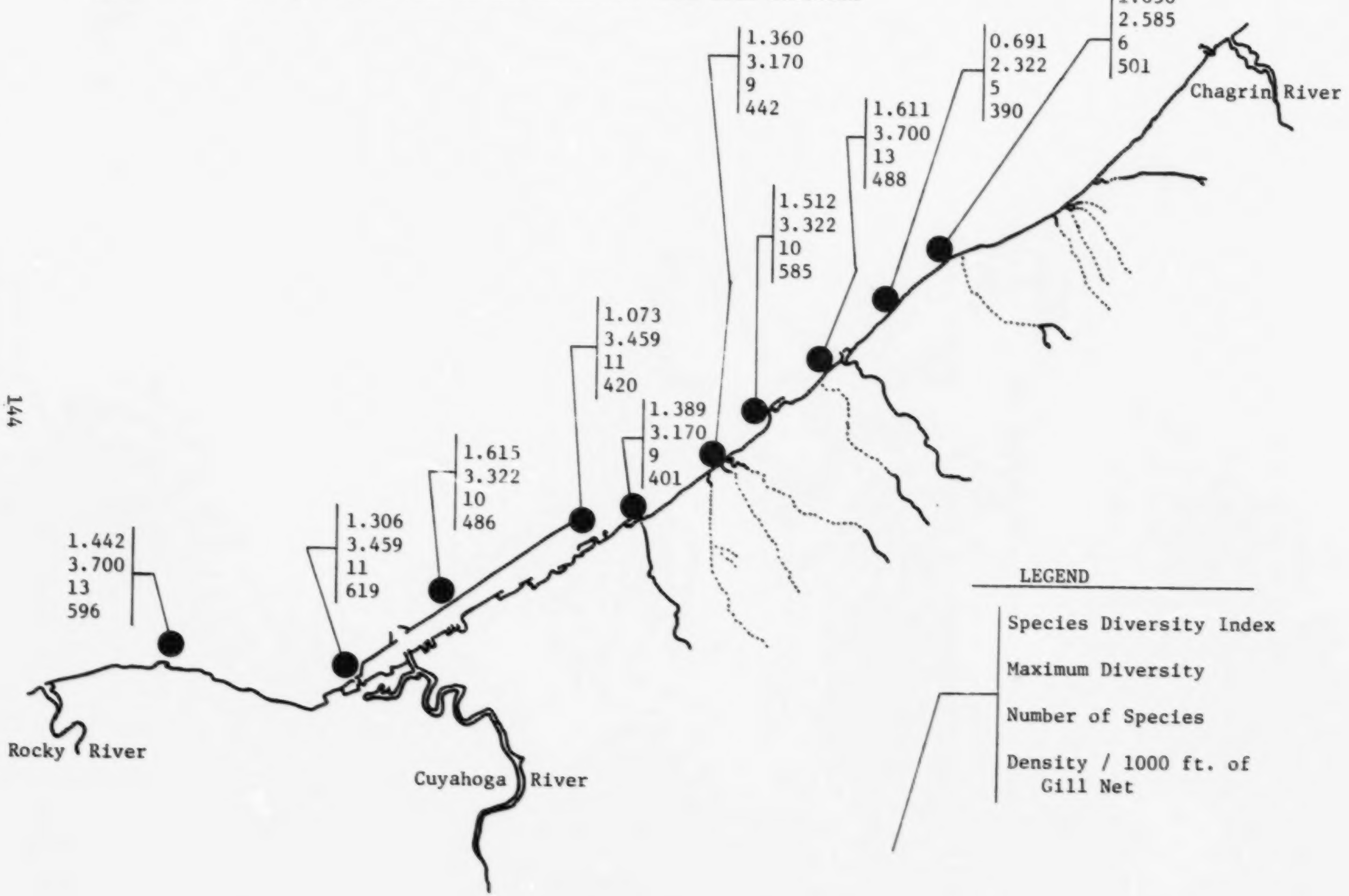
Species diversity indices of stations in the Lake were also found to fluctuate, although not as markedly as the rivers. Diversity fluctuations in the Lake collections were predominantly seasonal. We feel that this great fluctuation in the rivers indicates the frequent, although perhaps temporary, utilization of the lower rivers by both Lake Erie species and individuals from upstream areas. This tends to emphasize the importance of the lower river areas to both groups of fishes. Unfortunately, it is these areas which become polluted first.

Species Diversity in the Study Area

The species diversity index (Shannon-Weaver) was calculated for each of the ten intensive study stations in Lake Erie. It was found that the diversity was low, ranging from .691 to 1.615. While the index fluctuated slightly from sample to sample, it is possible to state that the diversity is rather uniform along the Cleveland shoreline at points one-half to one mile from shore. This reflects the high mobility of the species inhabiting these depths (25-30 ft.) as well as the lack of avoidance of the areas nearer to the mouth of the Cuyahoga River. The noticable differential between the species diversity index and maximum diversity (Figure 42) is reflective of the great predominance of the Yellow Perch and/or the Eastern Gizzard Shad in nearly every sample. These two species usually comprised more than 90% of each collection.

Samples taken nearer the shoreline, near the mouth of the Cuyahoga River or in shoreline marinas usually produced considerably higher diversities, and at the same time, more equivalent maximum diversities. This is because of the presence of a more diverse habitat, to the local attraction of shallower, more protected waters and in some cases, to the presence of warm water outfalls or sewage effluents. These latter factors have been shown to act as attractants for many species of fishes. In general, we have found that pollution sources are attractive to many Cleveland area fish species until they become toxic. This point is reached in some areas of the lower Cuyahoga River. Although fishes are usually present in this area in low numbers, the diversity usually approaches zero. Once the Cuyahoga flow mixes with the relatively cleaner harbor waters, the diversity becomes strikingly higher. Within 200 yards of the river mouth, (near the U.S. Coast Guard Station), the diversity index often reached a value of 3.00. This figure is higher than the usual value for the offshore stations in the vicinity of Cleveland.

Figure 42: Fish Population Data on Ten Intensive Lake Erie Stations



The highest diversities in the study area occur at the mouth of the Chagrin River, where collections often produce diversities over 4.00. Slightly lower diversities occur elsewhere in the Chagrin drainage, 3.00 to 3.50. In the Rocky River the diversities are usually 2.00 to 2.50, indicating a slightly depressed area. The Cleveland harbor and protected areas along the shoreline usually exhibit diversities of 2.50 to 3.00, while the offshore areas range from 1.00 to 1.50. The lower Cuyahoga River diversities range from 0.00 to 0.50, indicating an extremely distressed area. Figure 42 depicts the species population analysis for the ten Lake Erie study sites. Information pertaining to the distribution of fishes in the area rivers is contained in Table 9. The relative abundance of species in the study area is presented in Table 10; of the Lake and Lower Rivers in Table 11; of the Harbor area in Table 12. Fourty-seven species are included in the species composition of the Cleveland Harbor, of which many are probably reproducing (See page 128). Obviously the study area, Lake Erie or the Cleveland Harbor are not "virtually fishless" as has been stated by certain individuals in the past.

Summary of the General Decline of the Cleveland Area Fish Fauna

Literature reports and unpublished records indicate that the Cleveland metropolitan area contained, at one time or another, a total of 107 species and subspecies of fishes. The past literature indicated that prior to 1800 immense numbers of fishes were present.

The degradation of the area began early and its effects of the reduction of fish species and populations seemed to have occurred during three distinct periods. The first period of decline occurred between 1800 and 1830 and was primarily caused by the physical obstruction of streams by mill dams. These severely reduced the populations of those species blocked from their upstream spawning grounds. The second period began with the rapid expansion of industrialization and the concurrent growth of the City of Cleveland; resulting in the input of many pollutants into the Cuyahoga River. Between 1865 and 1890, the river and nearshore areas became heavily polluted with materials ranging from crude oil and raw sewage to sawdust and animal carcasses. This of course eliminated the lower river and shoreline spawning grounds for those species of fishes requiring such habitats.

During the 1950's another serious decline in Lake Erie species occurred. Such valued species as the Walleye, Blue Pike and Sauger declined rapidly. This decline has been unexplained but it is postulated that low dissolved oxygen levels in the deeper portions of Lake Erie are at least partially responsible.

Our present survey indicates that approximately 50% of those species reported for the Cleveland area are at this time either rare, endangered or probably extirpated within the study area (Table 8). Among those species most seriously affected are:

(1) those that are highly migratory stream spawning species such as the Lake Sturgeon, Muskellunge, Northern Pike or suckers. The initial cause of their decline is attributed to stream obstructions during the early 1800's. The more recent effects of draining and siltation have largely destroyed their former spawning grounds. This recent factor, combined with "chemical dams" of pollutants have rendered these species nearly non-reproductive in the Cleveland area.

(2) those species which were limited to the lower river habitats or to the nearshore areas of Lake Erie were seriously affected during the 1850 to 1900 period. Such species as the Longnose Dace, Largemouth Blackbass, Walleye, Northern Mimic Shiner and many others were adversly affected by the degradation of the nearshore waters and the pollution of the lower rivers. Most of these species depend upon habitats of clean sand or gravels, heavily vegetated bays or shoreline marshes. These species declined greatly prior to 1900, due to the destruction of their preferred habitat. It is probable that some of these species became extirpated from the area during this period.

(3) stream species which were intolerant of chemical, municipal pollutants or siltation were adversly affected in the upper areas of the stream drainages by the recent increase in human expansion into the suburbs. The Sand Darter, Bigmouth Shiner and Hornyhead Chub have continued to decline in areas where they were abundant in past years, due to siltation and pollution of the smaller streams and brooks. Poor land use planning and improper erosion control measures are of primary cause in these areas.

(4) those species that required colder, deeper portions of Lake Erie during the summer months were abundant on the Cleveland shoreline only during the winter or spring. Such species as the Lake Trout, Cisco, Burbot and others were recently affected by low dissolved oxygen levels in the deeper portions of the Central and Eastern Basins of the Lake. This is apparently the result of the accumulation of organic materials in the form of dead algae, sewage etc.

Table 8 : List of Fish Species which are Considered Rare, Probably Extirpated or Extirpated Within the Study Area.

Common Name	Scientific Name	Current Status
Silver Lamprey	Ichthyomyzon unicuspis	Rare
Sea Lamprey	Petromyzon marinus	Rare
Lake Sturgeon	Acipenser fulvescens	Probably Extirpated
Spotted Gar	Lepisosteus oculatus	Extirpated
Mooneye	Hiodon tergisus	Extirpated
Brown Trout	Salmo trutta	Rare
Brook Trout	Salvelinus fontinalis	Rare
Lake Trout	Salvelinus namaycush	Extirpated
Cisco	Coregonus artedii	Extirpated
Lake Whitefish	Coregonus clupeaformis	Extirpated
Northern Pike	Esox luscius	Rare
Lake Muskellunge	Esox m. masquinongy	Rare
Bigmouth Buffalofish	Ictobius cyprinellus	Extirpated
Eastern Quillback	Carpiodes c. cyprinus	Rare
Silver Redhorse	Moxostoma anisurum	Extirpated
Black Redhorse	Moxostoma duquesnei	Rare
Northern Redhorse	Moxostoma macrolepidotum	Rare
Longnose Sucker	Catostomus catostomus	Extirpated
Spotted Sucker	Minytrema melanops	Rare
Lake Chubsucker	Erimyzon sucetta	Rare
Hornyhead Chub	Nocomis biguttata	Rare
Silver Chub	Hybopsis storeriana	Extirpated
Longnose Dace	Rhinichthys cataractae	Rare
Pugnose Minnow	Notropis emiliae	Rare
Redfin Shiner	Notropis umbratilus	Rare
Bigmouth Shiner	Notropis dorsalis	Rare
Mimic Shiner	Notropis v. volucellus	Rare
Flathead Catfish	Pylodictus olivaris	Extirpated
Brindled Madtom	Noturus miuris	Extirpated
Tadpole Madtom	Noturus gyrinus	Extirpated
Eel	Anguilla rostrata	Extirpated
Burbot	Lota lota lacustris	Rare
Brook Silverside	Labidesthes sicculus	Rare
Orange-spotted Sunfish	Lepomis humilus	Rare
Longear Sunfish	Lepomis megalotis	Extirpated
Sauger	Stizostedion canadense	Extirpated
Walleye	Stizostedion v. vitreum	Rare
Blue Pike	Stizostedion v. glaucum	Extirpated (Extinct?)
Blackside Darter	Percina maculata	Rare
Channel Darter	Percina copelandi	Extirpated
Ohio Logperch Darter	Percina c. caprodes	Rare
Northern Logperch Darter	Percina c. semifasciata	Rare
Sand Darter	Ammocrypta pellucida	Extirpated
Scaly Johnny Darter	Etheostoma nigrum eulepis	Rare
Iowa Darter	Etheostoma exile	Extirpated
Central Mottled Sculpin	Cottus b. bairdi	Rare
Northern Mottled Sculpin	Cottus b. kumleini	Rare

Those species common or abundant within the study area are (1) species which spawn and live primarily in the open Lake (Drum, Emerald Shiner), (2) those which are highly pollution tolerant (Carp, Goldfish), (3) those which live in the extreme headwater tributaries which in most areas are relatively unaffected by human activities (Redside Dace), and (4) those species which nest, cleaning their eggs routinely thus freeing them of fine silts. Among these are the Sunfishes and Blackbasses, both of which are still common in the rivers. Sunfishes are still common in the Cleveland harbor and the Green Sunfish is one of the three species reproducing in the lower one mile of the Cuyahoga River.

In spite of the present condition of the fish fauna in the Cleveland metropolitan area almost all of the former species still may be found within the study area. Many of these are only found in isolated, small populations but it is important to realize that if the ecosystem were restored repopulation would result, thus restoring many of the species in the area. If the fishery in the Cleveland area is to be restored, two things must be done; (1) the present fish stocks must be protected so that potential repopulation sources are not lost prior to the improvement of the water quality and habitat availability and, (2), the immediate reversal of habitat destruction, water quality degradation, stream obstruction and uncontrolled land use. The latter approach is the goal of the U.S. and Ohio Environmental Protection Agencies. The protection of present fish stocks is further discussed in the section concerning recommendations.

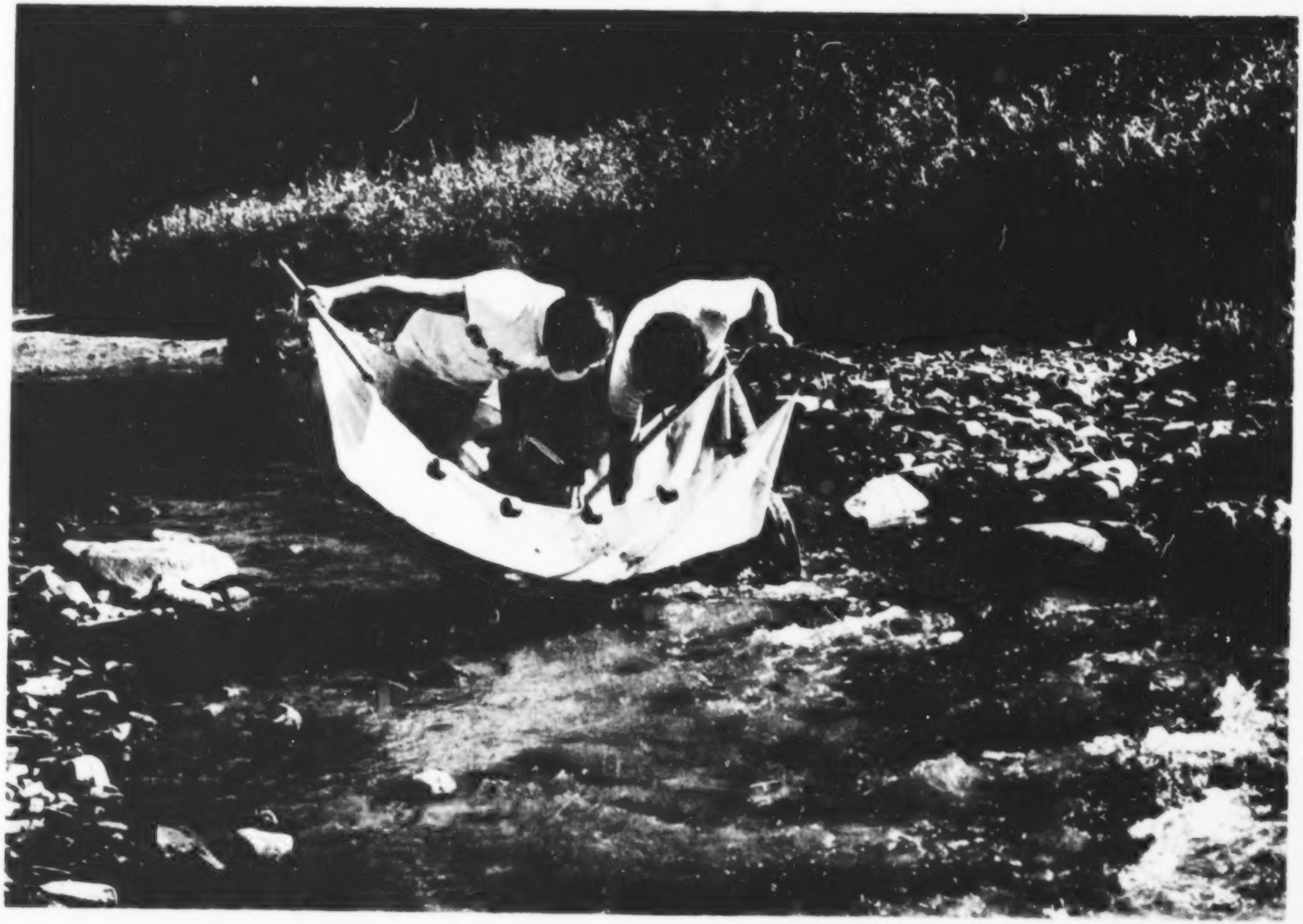


Figure 43: Headwater Habitat for Many of the More Uncommon Species of Cleveland Area Fishes.

Table 9: Distribution of Cleveland Area Fish Species in the Three River Drainages

SPECIES	CHAGRIN RIVER			ROCKY RIVER			CUYAHOGA RIVER		
	Upper	Middle	Lower	Upper	Middle	Lower	Upper	Middle	Lower
Silver Lamprey			X						
Sea Lamprey			X						
American Brook Lamprey	X	X							
Longnose Gar			X			X			
Bowfin			X			X			
Alewife			X			X			
Eastern Gizzard Shad			X		X	X			X
Chinook Salmon	X		X			X			
Coho Salmon	X		X			X			
Brown Trout	X								
Rainbow Trout	X	X							
Brook Trout	X								
Rainbow Smelt			X			X			X
Central Mudminnow	X			X	X		X		
Central Grass Pickerel	X	X	X		X		X		
Northern Pike			X				X		

Table 9: Stream Distribution of Fishes in Study Area (Continued)

SPECIES	CHAGRIN RIVER Upper	CHAGRIN RIVER Middle	CHAGRIN RIVER Lower	ROCKY RIVER Upper	ROCKY RIVER Middle	ROCKY RIVER Lower	CUYAHOGA RIVER Upper	CUYAHOGA RIVER Middle	CUYAHOGA RIVER Lower
Great Lakes Muskellunge			X						
Carp	X	X	X		X	X	X		X
Goldfish			X		X	X			X
Golden Shiner	X	X	X		X	X	X	X	X
Hornyhead Chub							X		
River Chub	X	X	X		X				
Northern Bigeye Chub	X	X	X						
Western Blacknose Dace	X	X		X	X		X	X	
Longnose Dace	X		X			X			
Creek Chub	X	X	X	X	X	X	X	X	
Southern Redbelly Dace	X			X					
Redside Dace	X			X				X	
Pugnose Minnow			X						
Common Emerald Shiner	X	X	X		X	X		X	X
Rosyface Shiner	X	X	X	X	X	X			
Northern Redfin Shiner			X			X			

Table 9: Stream Distribution of Fishes in Study Area (Continued)

SPECIES	CHAGRIN RIVER			ROCKY RIVER			CUYAHOGA RIVER		
	Upper	Middle	Lower	Upper	Middle	Lower	Upper	Middle	Lower
Striped Shiner	X	X	X		X	X	X		
Common Shiner	X	X		X	X		X		
Spottail Shiner			X			X			
Spotfin Shiner		X	X	X	X	X			
Central Bigmouth Shiner					X				
Northeastern Sand Shiner	X	X	X	X	X	X			
Northern Mimic Shiner			X	X	X	X			
Silverjaw Minnow	X	X	X	X	X	X		X	
Northern Fathead Minnow	X	X	X	X	X	X	X	X	
Bluntnose Minnow	X	X	X	X	X	X	X		
Stoneroller Minnow	X	X	X	X	X	X	X	X	
Eastern Quillback			X			X			
Central Quillback		X	X		X	X			
Black Redhorse		X	X						
Golden Redhorse	X	X	X		X	X			
Northern Shorthead Redhorse			X						

Table 9: Stream Distributions of Fishes in Study Area (Continued)

SPECIES	CHAGRIN RIVER			ROCKY RIVER			CUYAHOGA RIVER		
	Upper	Middle	Lower	Upper	Middle	Lower	Upper	Middle	Lower
Northern Hog Sucker	X	X	X		X		X		
Common White Sucker	X	X	X	X	X	X	X	X	
Spotted Sucker			X						
Western Lake Chubsucker							X		
Channel Catfish		X	X		X				
Yellow Bullhead	X	X	X		X		X		
Brown Bullhead	X	X	X		X	X	X		
Black Bullhead	X	X	X		X		X	X	
Stonecat Madtom		X	X		X				
Brook Silverside			X		X	X	X		
Brook Stickleback	X				X	X		X	
White Bass		X	X			X			X
White Crappie	X	X	X		X		X		
Black Crappie	X	X	X		X		X		
Rock Bass	X	X	X	X	X	X	X		
N. Smallmouth Blackbass	X	X	X		X	X	X		

Table 9: Stream Distributions of Fishes in Study Area (Continued)

SPECIES	CHAGRIN RIVER			ROCKY RIVER			CUYAHOGA RIVER		
	Upper	Middle	Lower	Upper	Middle	Lower	Upper	Middle	Lower
N. Largemouth Blackbass		X	X		X	X	X		
Warmouth Sunfish	X	X	X				X		
Green Sunfish	X	X	X	X	X	X	X	X	X
Bluegill Sunfish	X	X	X	X	X	X	X	X	
Orangespotted Sunfish			X						
Redear Sunfish							X		
Pumpkinseed Sunfish	X	X	X		X	X	X		
Walleye		X	X						
Yellow Perch	X	X	X			X	X		X
Blackside Darter	X	X					X		
Ohio Logperch Darter		X	X				X		
Northern Logperch Darter			X						
Central Johnny Darter	X	X	X	X	X		X		
Scaly Johnny Darter			X						
"Ozark" Greenside Darter			X						
"Allegheny" Greenside Darter	X	X	X	X	X				

Table 9: Stream Distributions of Fishes in Study Area (Continued)

SPECIES	CHAGRIN RIVER			ROCKY RIVER			CUYAHOGA RIVER		
	Upper	Middle	Lower	Upper	Middle	Lower	Upper	Middle	Lower
Rainbow Darter	X	X	X		X		X		
Barred Fantail Darter	X	X	X				X	X	
Freshwater Drum (Sheepshead)			X			X			X
Central Mottled Sculpin							X		

Table 10 : The Relative Abundance of Fishes Collected in the Cleveland Metropolitan Area Including Lake Erie, 1971-1974.

Species	No. Collected	% of Total
Silver Lamprey	1	0.001 %
Sea Lamprey	2	0.002
American Brook Lamprey	1	0.001
Longnose Gar	29	0.029
Bowfin	4	0.004
Alewife	5250	5.230
Eastern Gizzard Shad	6135	6.112
Rainbow Trout	403 *	0.402
Coho Salmon	44	0.044
Chinook Salmon	65	0.065
Rainbow Smelt	929	0.926
Central Mudminnow	38	0.038
Central Grass Pickerel	102	0.102
Northern Pike	16	0.016
Great Lakes Muskellunge	1	0.001
Eastern Quillback	12	0.012
Central Quillback	456	0.454
Black Redhorse	36	0.036
Golden Redhorse	160	0.159
Northern Shorthead Redhorse	8	0.008
Northern Hog Sucker	571	0.569

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* Collections of Rainbow Trout consist primarily of stocked young.

Table 10 : Continued, Cleveland Metropolitan Area Collections

Species	No. Collected	% of Total
Common White Sucker	1570	1.564 %
Spotted Sucker	2	0.002
Carp	477	0.475
Goldfish	166	0.165
Golden Shiner	886	0.883
Hornyhead Chub	15	0.015
River Chub	193	0.192
Northern Bigeye Chub	565	0.563
Western Blacknose Dace	1020	1.016
Longnose Dace	72	0.072
Northern Creek Chub	3296	3.284
Southern Redbelly Dace	33	0.033
Redside Dace	77	0.077
Pugnose Minnow	2	0.002
Common Emerald Shiner	10918	10.877
Rosyface Shiner	5775	5.754
Northern Redfin Shiner	2	0.002
Striped Shiner	766	0.763
Common Shiner	2103	2.095
Spottail Shiner	2091	2.083
Spotfin Shiner	3468	3.455
Central Bigmouth Shiner	2	0.002
Northeastern Sand Shiner	3109	3.097

Table 10 : Continued, Cleveland Metropolitan Area Collections

Species	No. Collected	% of Total
Northern Mimic Shiner	15	0.015 %
Silverjaw Minnow	5555	5.534
Northern Fathead Minnow	689	0.686
Bluntnose Minnow	20035	19.961
Ohio Stoneroller Minnow	2784	2.774
Channel Catfish	149	0.148
Yellow Bullhead	38	0.038
Brown Bullhead	139	0.138
Black Bullhead	171	0.170
Stonecat Madtom	84	0.084
Trout-perch	157	0.156
Brook Silverside	15	0.015
White Bass	1949	1.942
White Crappie	262	0.261
Black Crappie	180	0.179
Northern Rockbass	186	0.185
Northern Smallmouth Blackbass	321	0.320
Northern Largemouth Blackbass	255	0.254
Green Sunfish	278	0.277
Bluegill Sunfish	963	0.959
Orangespotted Sunfish	5	0.005
Pumpkinseed Sunfish	1820	1.813

Table 10 : Continued, Cleveland Metropolitan Area Collections

Species	No. Collected	% of Total
Warmouth Sunfish	25	0.025 %
Walleye	25	0.025
Yellow Perch	5592	5.570
Blackside Darter	44	0.044
Ohio Logperch Darter	2	0.002
Northern Logperch Darter	7	0.007
Central Johnny Darter	1372	1.367
Scaly Johnny Darter	1	0.001
"Ozark" Greenside Darter	1	0.001
"Allegheny" Greenside Darter	115	0.115
Rainbow Darter	912	0.909
Barred Fantail Darter	45	0.045
Freshwater Drum (Sheepshead)	589	0.588
Brook Stickleback	73	0.073
Northern Mottled Sculpin	1	0.001
Eastern Burbot	3	0.003
....		
Striped Shiner X Rosyface Shiner	7	0.007
Carp X Goldfish	218	0.217
River Chub X Northern Creek Chub	2	0.002
River Chub X Longnose Dace	2	0.002

Table 10: Continued, Cleveland Metropolitan Area Collections

Species	No. Collected	% of Total
Common Shiner X Striped Shiner	4362	4.346 %
Longnose Dace X Western Blacknose Dace	1	0.001
White Crappie X Black Crappie	8	0.008
Common Shiner X Redside Dace	1	0.001
Ohio Logperch Darter X Northern Logperch Darter	1	0.001
Central Johnny Darter X Scaly Johnny Darter	6	0.006
River Chub X Common Shiner	1	0.001
Green Sunfish X Pumpkinseed Sunfish	32	0.032
Brown Bullhead X Black Bullhead	9	0.009
Totals	100,376	100.005 %

Table 11 : The Relative Abundance of Fishes Collected in Lake Erie And the Lower Portions of the Three Rivers; Chagrin, Rocky and Cuyahoga, 1971-1974. Adult Specimens Only.

Species	No. Collected	% of Total
Silver Lamprey	1	0.002 %
Sea Lamprey	2	0.003
Longnose Gar	29	0.048
Bowfin	4	0.007
Alewife	5250	8.728
Eastern Gizzard Shad	6135	10.199
Rainbow Trout	2	0.003
Coho Salmon	44	0.073
Chinook Salmon	21	0.035
Rainbow Smelt	929	1.544
Central Grass Pickerel	45	0.075
Northern Pike	16	0.027
Great Lakes Muskellunge	1	0.002
Eastern Quillback	12	0.020
Central Quillback	446	0.741
Black Redhorse	10	0.017
Golden Redhorse	71	0.118
Northern Shorthead Redhorse	8	0.013
Northern Hog Sucker	27	0.045
Common White Sucker	724	1.204
Spotted Sucker	1	0.002
Carp	360	0.598

Table 11 : Continued, Lake Erie and Lower River Collections.

Species	No. Collected	% of Total
Goldfish	156	0.259 %
Golden Shiner	783	1.302
River Chub	27	0.045
Northern Bigeye Chub	26	0.045
Western Blacknose Dace	1	0.002
Longnose Dace	19	0.032
Northern Creek Chub	84	0.140
Pugnose Minnow	2	0.003
Common Emerald Shiner	10870	18.071
Rosyface Shiner	3317	5.143
Northern Redfin Shiner	2	0.003
Striped Shiner	412	0.685
Spottail Shiner	2091	3.476
Spotfin Shiner	3155	5.245
Northeastern Sand Shiner	1367	2.273
Northern Mimic Shiner	12	0.020
Silverjaw Minnow	348	0.579
Northern Fathead Minnow	22	0.037
Bluntnose Minnow	7560	12.568
Ohio Stoneroller Minnow	96	0.160
Channel Catfish	148	0.246
Yellow Bullhead	9	0.015
Brown Bullhead	112	0.186

Table 11 : Continued, Lake Erie and Lower River Collections

Species	No. Collected	% of Total
Black Bullhead	144	0.239 %
Stonecat Madtom	76	0.126
Trout-perch	157	0.261
Brook Silverside	14	0.023
White Bass	1949	3.240
White Crappie	233	0.387
Black Crappie	171	0.284
Northern Rockbass	65	0.108
Northern Smallmouth Blackbass	173	0.288
Northern Largemouth Blackbass	215	0.357
Green Sunfish	87	0.145
Bluegill Sunfish	749	1.245
Orangespotted Sunfish	5	0.008
Pumpkinseed Sunfish	1596	2.653
Warmouth Sunfish	13	0.022
Walleye	25	0.042
Yellow Perch	5528	9.190
Blackside Darter	14	0.023
Northern Logperch Darter	6	0.010
Central Johnny Darter	231	0.384
Scaly Johnny Darter	1	0.002
"Ozark" Greenside Darter	1	0.002
"Allegheny" Greenside Darter	5	0.008

Table 11: Continued, Lake Erie and Lower River Collections

Species	No. Collected	% of Total
Rainbow Darter	76	0.126 %
Barred Fantail Darter	1	0.002
Freshwater Drum (Sheepshead)	589	0.979
Brook Stickleback	5	0.008
Northern Mottled Sculpin	1	0.002
Eastern Burbot	3	0.005
Carp X Goldfish	218	0.362
Common Shiner X Striped Shiner	3022	5.240
White Crappie X Black Crappie	8	0.013
Ohio Logperch Darter X Northern Logperch Darter	1	0.002
Central Johnny Darter X Scaly Johnny Darter	6	0.010
Brown Bullhead X Black Bullhead	9	0.015
Totals	60,153	99.854 %

Table 12 : The Relative Abundance of Fishes Collected in the Cleveland Harbor and Adjacent Marinas (Revised July, 1974)

Species	No. Collected	% of Total
Longnose Gar	1	0.01 %
Alewife	92	0.85
Eastern Gizzard Shad	2525	23.43
Chinook Salmon	9	0.08
Coho Salmon	42	0.39
Rainbow Trout	2	0.02
Rainbow Smelt	323	3.00
Northern Pike	15	0.14
Carp	64	0.59
Goldfish	97	0.90
Golden Shiner	393	3.65
Longnose Dace	1	0.01
Creek Chub	1	0.01
Western Blacknose Dace	1	0.01
Common Emerald Shiner	4092	37.97
Striped Shiner	1	0.01
Spottail Shiner	903	8.38
Spotfin Shiner	6	0.06
Northeastern Sand Shiner	33	0.31
Northern Mimic Shiner	6	0.06
Northern Fathead Minnow	1	0.01
Bluntnose Minnow	74	0.69

Table 12 : Continued, Cleveland Harbor and Marina Collections

Species	No. Collected	% of Total
Stoneroller Minnow	2	0.02 %
Eastern Quillback	1	0.01
Black Redhorse	1	0.01
Golden Redhorse	2	0.02
Northern Shorthead Redhorse	1	0.01
Common White Sucker	89	0.83
Channel Catfish	2	0.02
Brown Bullhead	23	0.21
Black Bullhead	14	0.13
Stonecat Madtom	13	0.12
Trout-perch	153	1.42
Brook Silverside	3	0.03
White Bass	223	2.07
White Crappie	80	0.74
Black Crappie	11	0.10
Northern Rockbass	5	0.05
Northern Largemouth Blackbass	3	0.03
Warmouth Sunfish	1	0.01
Green Sunfish	3	0.03
Bluegill Sunfish	4	0.04
Pumpkinseed Sunfish	34	0.32

Table 12 : Continued, Cleveland Harbor and Marina Collections

Species	No. Collected	% of Total
Yellow Walleye	2	0.02
Yellow Perch	1254	11.64
Northern Logperch Darter	1	0.01
Freshwater Drum (Sheepshead)	170	1.58
TOTALS 47 Species	10,777	100.05 %

SECTION VII

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